Advancing Work Practices Through Online Professional Development

A Study of the Effectiveness of Online Professional Development Illustrated by an Empirical Case of Danish K-5 Science Teachers

Noesgaard, Signe Schack

DOI (link to publication from Publisher):
10.5278/VBN.PHD.HUM.00066

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

ADVANCING WORK PRACTICES THROUGH ONLINE PROFESSIONAL DEVELOPMENT

A STUDY OF THE EFFECTIVENESS OF ONLINE PROFESSIONAL DEVELOPMENT ILLUSTRATED BY AN EMPIRICAL CASE OF DANISH K–5 SCIENCE TEACHERS

BY
SIGNE SCHACK NOESGAARD

DISSERTATION SUBMITTED 2016

AALBORG UNIVERSITY
DENMARK

ADVANCING WORK PRACTICES THROUGH ONLINE PROFESSIONAL DEVELOPMENT

A STUDY OF THE EFFECTIVENESS OF ONLINE PROFESSIONAL DEVELOPMENT ILLUSTRATED BY AN EMPIRICAL CASE OF DANISH K–5 SCIENCE TEACHERS

by

Signe Schack Noesgaard

AALBORG UNIVERSITY
DENMARK

Dissertation submitted

.

Dissertation submitted: December 15, 2016

PhD supervisor: Prof. Rikke Ørngreen
Aalborg University

PhD committee: Lektor Lars Birch Andreasen
Aalborg Universitet

Professor Amanda Jefferies
University of Hertfordshire School of Computer Science

Associate Professor Mélanie Ciussi
SKEMA Business School

PhD Series: Faculty of Humanities, Aalborg University

ISSN (online): 2246-123X
ISBN (online): 978-87-7112-850-5

Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Printed in Denmark by Rosendahls, 2017

CV

I received my Master of Arts (cand.mag.) in Education from the University of Copenhagen in 2008. At the University of Copenhagen, I specialized in adult education, which laid the foundation for my continuous interest in professional development. During my undergraduate studies, I had the pleasure of spending my elective year at Washington College, Maryland, where I studied leadership behavior, psychology, and business administration. I spent another year in the United States during my master's degree studies, this time at UC Berkeley, studying educational sociology. While still graduate student, I was hired at A.P. Møller – Maersk, where I spent six years as Learning Project Manager and Learning Partner. My work included multiple e-Learning developments aimed at improving employee performance. These projects marked the beginning of my quest to understand how IT can be leveraged for effective professional development. Alongside my professional work, I completed an HD1 in Business Economics at Copenhagen Business School. Since 2013, I have been an industrial PhD student at the KATA Foundation (formerly the Universe Foundation) and Alborg University, Department of Learning and Philosophy. In the course of my PhD studies, I spent four months in California at Stanford University's SCANCOR and H-STAR institutes. Stanford University has been the formal third party to my PhD project. After my PhD studies, I will head up a start-up dedicated to delivering leadership development technologies. These technologies will be based on many of the findings of this dissertation.

ENGLISH SUMMARY

This article-based dissertation presents an industrial PhD project that investigated whether, why, and how online professional development interventions advance work practices. The dissertation includes three journal articles and two conference articles investigating different aspects of online professional development.

Initially, the dissertation delivers a meta-review exploring the definitions and methodologies applied in the field of e-Learning effectiveness. The review finds great diversity in the definitions of effectiveness but little diversity in the research methods applied; the field predominantly uses quantitative methods comparing face-to-face interventions with online interventions. Inspired by design-based research, the empirical dissertation research takes a different approach and aims for an in-depth investigation of the variation and complexity in practitioners' learning transfer trajectories and the contextual contingencies of their practices. Specifically, the main empirical case study involves seven Danish K–5 science teachers who participated in an online professional development initiative aimed at introducing inquiry-based teaching methods in their classrooms. The data, which are predominantly qualitative, consist of observations, unstructured interviews, and surveys of teaching practices before, during, and after the intervention. Observation consisted of in-class observations as well as teachers' interactions with the online learning content.

The variation in teachers' change in practice is unfolded through a social constructionist perspective on an informed grounded analysis; the analysis centers on the teachers' narratives and strategies in defining effectiveness. A finding of the analysis highlights how the practitioners must be able to evidence immediate value in their work without having to invest substantial extra time to change. As part of this analysis, the concept of teacher frustration in transferring learning into practices is explored, and frustration is found to be at the tipping point of either substantial change or a return to the status quo.

The social constructionist perspective also highlights the importance of analyzing different views about what constitutes an "advancement," because this evidently influences whether, why, and how changes to practices do or do not occur.

After concluding the empirical case, the dissertation uses the findings to highlight a need to rethink the instructional course frame that is applied in most online professional development interventions. Specifically, it suggests rethinking e-Learning into adaptive and "just-in-time" learning technologies that take into account the specificities of learning in professional settings. In this regard, the opportunities for extending the findings to other professional development domains are discussed and re-designs are considered.

Ultimately, revised design principles are suggested, constituting a design theory of situated online professional development. At its core is the need for online professional development to adapt to the complexity and context dependencies of practices in order to advance work practices.

DANSK RESUME

Denne artikelbaserede afhandling præsenterer et erhverv-ph.d.-projekt, som har undersøgt hvorvidt, hvorfor og hvordan online kompetenceudviklingsinterventioner kan forandre arbejdspraksis. Afhandlingen indeholder tre tidsskriftsartikler og to konferenceartikler, som alle undersøger forskellige aspekter af online kompetence-udvikling.

Afhandlingen starter ud med et litteraturstudie, der udforsker definitioner og metoder anvendt i det forskningsfelt, der undersøger effektiviteten af e-læring. Studiets resultater viser stor diversitet i måden, hvorpå e-lærings effektivitet defineres, men begrænset diversitet i forskningsmetoder anvendt. På feltet anvendes overvejende komparative kvantitative metoder, der sammenligner fremmødeinterventioner med online interventioner.

Inspireret af designbaseret forskning (Design-Based Research), tager afhandlingen empiriske forskning en anden tilgang og leverer en dybdeborende undersøgelse af variation og kompleksiteten i praksislæring og adfærdsændring qua kontekstuelle forhold i relation til online kompetenceudvikling. Det primære empiriske studie involverer syv danske folkeskolelærere, som deltog i et online kompetence-udviklingsinitiativ, der havde til formål at forbedre undervisning i natur/teknologi via anvendelsen af naturvidenskabelige metoder i undervisningen. Den indsamlede data er primært kvalitativt og indbefatter klasserumsobservationer og interventions-observationer med ustrukturerede interview samt spørgeskemaundersøgelser før, under og efter interventionen.

Variationen i lærernes praksisforandring bliver udfoldet gennem et social-konstruktionistisk perspektiv på en informeret 'grounded' analyse; analysen centrerer sig om lærernes narrativer og strategier i deres sociale samspil. Heri understreges vigtigheden af, at praktikeren kan få interventionerne til at skabe umiddelbar og ikke-tidskrævende værdi i praksis. Lærernes frustration i implementeringen af kompetenceudviklingsinitiativer sættes under luppen, og frustrationen vurderes som et afgørende punkt, hvorfra lærernes praksis enten forandres væsentligt eller ubetydeligt afhængigt af måden, hvorpå frustrationen håndteres.

Med den socialkonstruktionistiske tilgang anerkender afhandlingen vigtigheden af at analysere aktørpositioners potentielt set divergerende konstitueringer af effektivitet og praksisforbedring. Det må antages at forskellige definitioner påvirker hvorvidt, hvorfor og hvordan forandring af praksis finder sted.

Afhandlingen konkluderer på lærercasen og anvender resultaterne til at understrege nødvendigheden af at gentænke kursusrammen som de fleste online kompetence-udviklingsinitiativer anvender. Der foreslås konkret at gentænke e-læring til at blive

adaptive ”just-in-time” læringsteknologier, som kontinuerligt supporterer praktikeren i den professionelle praksis. I den forbindelse diskuteres muligheder for at udvide de empiriske fund til andre kompetenceudviklingsdomæner og design hertil bliver konkretiseret.

Slutteligt bliver reviderede didaktiske design principper fremlagt. Tilsammen danner design principperne en design teori, der benævnes ”situeret online kompetenceudvikling”. Teoriens omdrejningspunkt er behovet for, at online kompetenceudvikling i højere grad end hidtil anerkender kompleksiteten i at forandre praksis og, at interventioner kontinuerligt tilpasser sig kontekstuelle behov. Design principperne udstikker retningslinjer for, hvordan online kompetenceudvikling kan gentænkes for at fremme interventionsbaseret vedvarende forandringer og de deraf følgende forbedringer af arbejdspraksis.

ACKNOWLEDGMENTS

I am grateful to the many warm and generous people who have enriched my PhD study. I would especially like to extend my gratitude to the following:

The KATA Foundation for supporting and funding the PhD project. I would like to thank all my great colleagues at KATA for their passion, for our everyday philosophical discussions, and for our many fun experiences. A special thank you to my company advisor, Jesper Ingerslev, who helped me gain access to the schools and also assisted in collecting the empirical data for the PhD study. Thank you to the schools and their principals and teachers; thank you for your engagement and courage to be challenged. Thank you to the students and their parents for allowing me into their classes.

The Danish Innovation Foundation for approving and funding the project.

My supervisor, Prof. Rikke Ørngreen, for her relentless and encouraging support. For always being only a click or call away. For her visit at Stanford. For her ability to listen and motivate. For her hard work when writing together and for her extensive reading of and valuable comments on my individual work.

Aalborg University (ILD Lab) for academic sparring and good moods. I would like to point out the pleasure of working with Anna Neustrup Nielsen. Associate Prof. Karin Levinsen also deserves a special thank you for her hard work and insightful comments as the opponent to the pre-defense.

Stanford University (SCANCOR and HSTAR) for inspiration, outlook, and countless learning opportunities. I would especially like to thank Prof. Hilda Borko, Dr. Florencia Gomez Zaccarelli, and Prof. Keith Devlin for inspiration and outlook. Thank you to the SCANCOR and Lytics LAB scholars for our weekly presentations and discussions, many of which became defining moments in my PhD research.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PUBLICATIONS

This list includes research articles published during the PhD study.
Articles marked with (*) are printed in this dissertation.

***Noesgaard, S. S. (2014).** Supporting transfer of learning: Practice-based considerations on the applicability of transfer literature in online design. *Proceedings of the 4th International Designs for Learning Conference* (pp. 1–5). Stockholm, Sweden.

***Noesgaard, S. S. (2016a).** Advancing work practices: Rethinking online professional development in the context of intervention-based sustainable change. *Interactive Technology and Smart Education*, *13*(4), pp. 246-260.

Noesgaard, S. S. (2016b). Can E-learning change work practices? *Proceedings of the Multi Conference on Computer Science and Information Systems (MCCSIS) 2016; E-Learning 2016*. Madeira, Portugal.

***Noesgaard, S. S. (2016c).** Teacher frustration and professional development: Causes, consequences and practical implications. Manuscript submitted for publication, December 2016.

Noesgaard, S. S., & Ørngreen, R. (2014). Understanding and utilizing the definitions of the effectiveness of E-learning. *Proceedings of the 13th European Conference of E-Learning ECEL-2014* (pp. 445-454). Copenhagen, Denmark.

***Noesgaard, S. S., & Ørngreen, R. (2015).** The effectiveness of e-Learning: An explorative and integrative review of the definitions, methodologies and factors that promote e-Learning effectiveness. *The Electronic Journal of E-Learning*, 13(4), 278-290.

***Ørngreen, R., Jørgensen, A. N., & Noesgaard, S. S. (2016).** Mobile probes: A scaffold for peer and self-regulated learning. *Proceedings of the 5th International Conference on Designs for Learning* (pp. 283–299). Copenhagen, Denmark.

CHAPTER 1. INTRODUCTION

The advent of the internet has permanently changed the way millions of people connect, communicate, and collaborate, personally as well as professionally. Digital technologies alter our brains and continuously change how we feel, learn, and behave (Small & Vorgan, 2008). A workday without Outlook, Google, and our smartphones at our sides is incomprehensible for many professionals today, especially for the so-called "digital natives" who are soon to become the majority of the workforce; these young professionals have never known a world without computers and are fluent in technologies more advanced than those traditionally present in the workplace. Work is continuously changing.

Technological innovations have impacted the way professional development interventions are delivered. E-learning is no longer only an add-on to traditional face-to-face-courses. It has been an integrated part of work practices for more than a decade (Ciussi & Freitas, 2012). Concurrently, learning and development departments in organizations across industries have increasingly been delivering professional development opportunities to their employees via self-paced online courses (Ho, Maris, & Jones, 2015).

Inside and outside educational institutions, the largest educational digital change in recent years has been the proliferation of Massive Open Online Courses (MOOCs). These are courses conveyed openly via the internet. Although MOOCs have developed into diverse designs applying diverse learning pedagogies (see Andreasen & Buhl, 2015), they have primarily consisted of short video lecture segments replicating the stand-and-lecture pedagogies of conventional classrooms with added multiple-choice questions and audience discussion. Although MOOCs are intended for "everyone," they have primarily been used by professionals who have already completed their formal education, thus providing life-long learning opportunities (Kizilcec, Piech, & Schneider, 2013, as cited in Ciussi et al., 2015).

Online professional development allows learning and development departments and public administrators to lower their professional development costs while providing employees with access to a greater variety of courses. Despite challenges of persistence in online courses, employees who have completed MOOCs often rate their satisfaction "high," and pre- and post-tests frequently show high learning outcomes for employees (see review in Noesgaard & Ørngreen, 2015).

At their core, however, professional development initiatives are attempts to improve work by supporting employees to become competent practitioners; professional development is about advancing practices. Will online courses support practitioners in improving their practices? Can online professional development interventions advance work practices?

1.1. RESEARCH QUESTIONS

With the objective to investigate the use of online professional development as a means of advancing work practices, this dissertation aims to answer the following research questions:

1. To what extent are online professional development interventions effective in advancing work practices?
2. When and under which conditions can oPDIs be effective in advancing work practices?
3. How can online professional development interventions be effective in advancing work practices?

The industrial PhD project has had three corresponding high-level objectives, which are reflected in the three research questions:

1. Timely evaluation of the effectiveness of an online platform for the KATA Foundation
2. Research on the complexity and contradictions in professional development effectiveness
3. Enhancing online PD design theory for improved work practices

All three research questions are continuously addressed throughout the dissertation, although certain chapters focus specifically on one of the questions. Thus, the first question is answered through an integrative literature review and a discussion of evaluation and measurements of the effectiveness of online professional development, including findings from the empirical case (Chapters 2 and 8). The aim in answering the second research question is to further an understanding of some of the complexities and contradictions in intervention-based changes to professional practices and the strengths and limitations of online delivery (Chapters 9 and 12). The third research question leads to a discussion and proposal for design principles and alternative designs for effective online professional development based on the findings of the dissertation (Chapters 12 and 13).

The dissertation operates with a group of key terms that can have multiple meanings and applications depending on academic field and context. The following sub-sections serve to briefly define key terms and abbreviations as they will be applied in the dissertation.

1.1.1. PROFESSIONAL DEVELOPMENT

In this dissertation, *professional development* (PD) is defined as an advancement of the way we work as professional practitioners to the benefit of the people we serve. The term *practitioner* is given the broadest possible definition to encompass

employees of any occupation, such as teachers, nurses, engineers, and managers. Thus, professional development bridges fields of adult learning, continuous learning, corporate learning and development, and teacher professional development. The practitioner will often be referred to as the *employee*. These two terms are used interchangeably.

The term *student* refers solely to the students of teachers and not to the practitioners themselves. Thus, when practitioners engage in professional development, they may be called *participants*, but never *students*. Relatedly, in the empirical case, the PhD study focuses on the teachers' learning and development – not the students'. As will become evident, however, the students are key players in the teachers' perceptions of oPD effectiveness.

Professional development intervention (PDI) refers to formalized continuous learning activities or requirements for practitioners. PDIs are any structured competence development initiatives aimed at improving or maintaining the work performance of professionals. PDIs may include any explicitly planned course, seminar, or material; PDIs may also include coaching or mentoring of any duration, structure, combination, or delivery method (Jasper, 2006; Noesgaard, 2016b).

1.1.1.1 Online Professional Development

Online professional development (oPD) refers to professional development occurring by means of online technology. A simple Google search could become oPD, provided that the search result enabled the employee to alter her practice, thus developing professionally. An *online professional development intervention* (oPDI) is a formal initiation of an online mediated PD process that aims to address a practitioner's specific PD needs with the objective of advancing practices.

In the articles of the dissertation, oPD is commonly referred to as e-Learning, online intervention, or similar terms; at times, it is also specified as MOOCs or online courses. These terms should be understood as interchangeable unless otherwise indicated.

1.1.1.2 Teacher Professional Development

The scope of this dissertation is professional development across professional practices and organizations. As the empirical case resides within teacher professional development (TPD), however, this field deserves special attention in the dissertation. The only change to the definitions of PD and oPD is, however, the specified practitioner – the teacher.

The core of teachers' jobs – teaching students – is performed individually in the classroom. In addition, Danish teachers commonly plan and prepare their teaching individually (Noesgaard, 2014). With autonomy and individuality at the heart of the

teaching profession in Denmark, the potential advancement of practices is largely viewed as a question of individual behavior change. At the same time, the PhD project acknowledges learning as fundamentally social and situated. The importance of understanding learning as situated becomes increasingly evident throughout the dissertation, as situated learning theory proved to be a necessary explanatory frame for the empirical case.

1.1.2. WORK PRACTICES

Work practices are the activities and interactions performed as part of the practitioner's occupational tasks while the practitioner is acting as a representative of the profession. Professional work practices and professional development are interdependent; work practice will not develop unless we develop as professionals (Jasper, 2006). Professional development is, however, not only a result of PDIs; most PD occurs when practicing the profession itself. Despite the impossibility of completely separating PDI-based change from PD, the former is defined as occupational activities that are performed differently than was observed or experienced prior to the PDI.

1.1.3. ADVANCEMENT

Advancement in this dissertation is defined as a positive change of work behaviors. This definition immediately raises a number of questions. What exactly is a positive change? Who makes that determination? Who benefits from the change? A positive change can be defined in at least as many ways as there are oPDI stakeholders. This dissertation centers on the definitions of three stakeholder positions: 1) oPDI initiator, 2) the practitioners, and 3) the researcher. The term *advancement* is always used to reflect a positive change in practices; change, however, can be a change for the worse or can be imposed where no change is desirable for either the initiators or the participants. The term *change* is generally applied with its positive connotation, similar to *advancement*; when negative change is meant, this will be stated explicitly.

Of specific interest is advancement in practices, in which change is not a sanctioned requirement; the practitioners are not required to change their practices, nor will there be any negative consequences for them if they do not. Instead, change is deemed necessary by the oPDI initiator and possibly – but not necessarily – by the practitioners. This dissertation's empirical case is an example of such a PDI.

1.1.4. EFFECTIVENESS

In this dissertation, the *effectiveness* of an oPDI is the degree to which it is successful in advancing work practices. Establishing links between learning interventions and results in practices is much more complex than is often acknowledged. A critical field to investigate in this regard is the *transfer of learning* field, which deals with the extent

to which learning outcomes from interventions “transfer” to changes in practices. The literature on transfer of learning is presented and discussed theoretically as well as empirically in Chapter 5. The concept of effectiveness in online learning is investigated at length in Chapter 2.

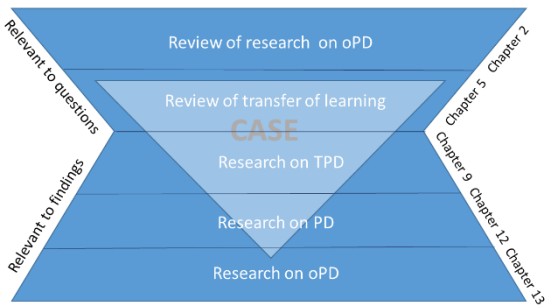
In sum, an effective oPDI is characterized by a change in practitioner activities and interactions resulting in an advancement of individual work practices as observed by PDI initiators, the practitioners, the researcher, or any combination of the three. The definition will be further developed in the literature review in Chapter 2.

CHAPTER 2. LITERATURE REVIEW: THE EFFECTIVENESS OF ONLINE PROFESSIONAL DEVELOPMENT

This chapter provides a review of the literature addressing the effectiveness of online professional development (oPD). The chapter falls into two sections. The primary section consists of Article A, which reviews international empirical research on e-Learning effectiveness across adult learning domains. This includes preliminary findings of one of the studies of the empirical case of the PhD project, which will be explained in detail in Chapter 7. The second part of this chapter highlights how key findings from the literature review inform the topics and methodology of the remainder of the dissertation.

Figure 1 illustrates how extant research is reviewed and applied throughout the dissertation. The PhD project aims to contribute to the field of oPD broadly. The double trapezoid shape of Figure 1 depicts the use of extant literature in the dissertation, which begins with a review of the effectiveness of oPD (Chapter 2) and then narrows its focus to the transfer of learning literature (Chapter 5) and the TPD domain of the empirical case (Chapter 9). Guided by the findings derived from the empirical case, the dissertation opens up to the broader field of PD in order to take a step back and discuss intervention-based change across modalities (Chapter 12). This discussion calls for a rethinking of oPD; therefore, the dissertation centers finally on research related to proposed design principles and new technologies which could be leveraged for oPD (Chapter 12). The light blue triangle represents the empirical case, illustrating the focus on empirical data that begins in Chapter 5. As the dissertation narrows in on key empirical findings, literature that informs these findings is increasingly added. This results in design principles with the aim of contributing to the broader field of oPD (Chapter 13).

Figure 1: High-level Overview of oPD Literature used in the Dissertation



2.1. ARTICLE A

The Effectiveness of e-Learning: An Explorative and Integrative Review of the Definitions, Methodologies and Factors that Promote e-Learning Effectiveness

Authors: Signe Schack Noesgaard (lead author) & Rikke Ørngreen

The article was published in the *Electronic Journal of e-Learning*, 2015, Volume 13, Issue 4, pp. 278–290.

A similar conference article was published in the *Proceedings of the 13th European Conference of E-Learning ECEL-2014*, Copenhagen, Denmark. This conference paper was short-listed and an extended version invited for publication in *Electronic Journal of e-Learning*.

The Effectiveness of e-Learning: An Explorative and Integrative Review of the Definitions, Methodologies and Factors that Promote e-Learning Effectiveness

Signe Schack Noesgaard[1,2] and Rikke Ørngreen[2]
[1]Kata Foundation, Sønderborg, Denmark &
[2]ResearchLAB: IT and Learning Design, Dep. of Learning and Philosophy, Aalborg University, Copenhagen, Denmark
ssn@learning.aau.dk
rior@learning.aau.dk

Abstract A structured search of library databases revealed that research examining the effectiveness of e-Learning has heavily increased within the last five years. After taking a closer look at the search results, the authors discovered that previous researchers defined and investigated effectiveness in multiple ways. At the same time, learning and development professionals within public and private organisations are increasingly being asked to prove the effectiveness of their learning and development initiatives. This paper investigates the effectiveness of e-Learning through an integrative review. The paper answers the following research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective? The authors discovered 19 distinct ways to define effectiveness, the most common of which is 'learning outcome', appearing in 41 % of the articles examined in the literature review. Moreover, the most common way to measure effectiveness is quantitatively with pre- and post-tests. This paper includes an empirical study of an e-Learning solution for science teachers (K–12) which serves as a valuable addition to the findings of the literature study. The study suggests that it is difficult to use e-Learning to improve teaching performance, as participating teachers can apply several strategies to avoid substantially changing their work-related practices. Furthermore, the study shows that only using the fulfilment of pre-defined learning objectives as an effectiveness parameter does not allow developers and researchers to see unexpected and unintended changes in practice that occur as a result of the e-Learning program. Finally, the research provides insight into the validity of self-assessments, suggesting that participants are able to successfully report their own practices, provided certain qualitative survey approaches are used. In this paper, a model for understanding the relationships of the key factors that influence effectiveness is developed. The model categorises these factors from three perspectives: the context in which the e-Learning solution is used, the artefact (the e-Learning solution itself) and the individuals that use the artefact. It was found that

support and resources, the individuals' motivation and prior experience and interaction between the artefact and the individuals that use it all influence effectiveness. Towards the end, this paper discusses whether e-Learning and traditional face-to-face learning should be measured according to the same definitions of and approaches to effectiveness, ending with a call for learning designers and researchers to target their measurement efforts to counting what counts for them and their stakeholders.

Keywords: effectiveness, e-Learning, adult learning, literature study, definition, measurement

1. Introduction

Research examining the effectiveness of e-Learning has increased in recent years. This is primarily due to the increased possibilities for IT and learning as well as increased political and organisational attention to 'what works' in learning. Figure 1a shows the 761 papers relevant to this research, and Figure 1b shows 111 intensively coded abstracts of the 761 papers (which are described in further detail in the methodology section below). There are fewer papers published in 2013 than in any other year because the structured search took place in October 2013.

In the following analysis, the authors investigate the research into the effectiveness of e-Learning. The paper is structured around three research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective? The aim of the literature study is to organise similar research in order to better understand the characteristics and tendencies as well as connections between the applied concepts.

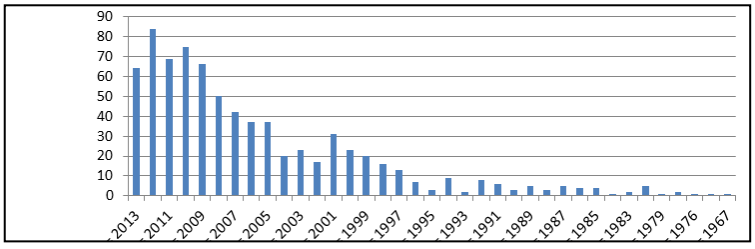


Figure 1a: Number of published papers per year

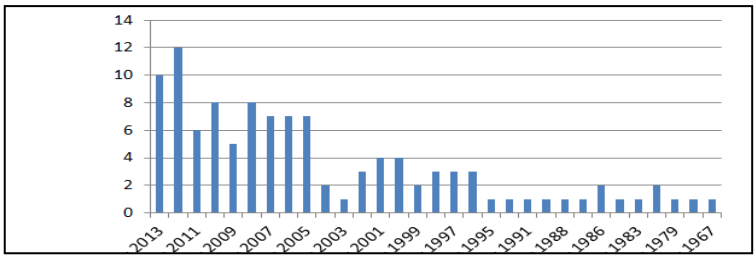


Figure 1b: Number of published papers with coded abstracts per year

1.1 Literature study - methodology

Several systematic reviews and meta-studies on the effectiveness of e-Learning exist within the context of health care or language learning. These reviews primarily include quantitative studies based on certain criteria, such as sample size (Veneri, 2011), transparency of statistical information (Grgurovic, Chapelle and Shelley, 2013; Means et al, 2013) or homogeneity of the respondents and predefined outcome measures (Rosenberg, Grad and Matear, 2003). Only one relevant meta-review, which included both qualitative and quantitative studies in an integrative review evaluating the outcome of distance learning for nursing education, was found (Patterson, Krouse and Roy, 2012).

The quantitative meta-reviews aimed to document the effectiveness of e-Learning by consolidating the data of a number of quantitative studies. The mixed-method meta-review mentioned above describes the state of the research, explains how the studies evaluate different outcomes and discusses different aspects of learning effectiveness. This is somewhat similar to the present paper, which also applies a mixed-method methodology in an integrative manner. However, many more research articles are considered in this paper due to broader selection criteria. Hence, this paper is not concerned with re-investigating how effective e-Learning is, but rather with understanding the definitions, measurements and factors promoting e-Learning effectiveness.

The authors aimed to obtain a broad foundation of high-quality papers, from which a large but not pre-defined number was chosen for further investigation. Papers were chosen using a strategic randomised approach based on a purposive sample size, then analysed based on the concept of theoretical saturation (that is, the point at which new data no longer provide further insight into the subject at hand). In this integrative review, data analysis, data reduction and data displays are equally important (Whittermore and Knafl, 2005).

The authors conducted conventional subject searches in 30 academic databases (J-stor, Scopus and Proquest, which includes 28 databases) to discover articles examining the effectiveness of e-Learning within the context of adult learning (see

Table 1). All fields of research were included in the searches, as e-Learning can be used to support any subject. The searches only included articles in English, and where possible, only from peer-reviewed journals. The chosen synonyms for 'effectiveness' include 'transfer' and 'application', which may have resulted in an overrepresentation of articles that define effectiveness as the application of learning content into work practices.

The searches resulted in almost 1000 articles. Articles clearly irrelevant to the subject were excluded, lowering the number to 761. If an article contained an empirical study on the effectiveness of e-Learning and the solution under investigation was targeted at working professionals or adult students, then the abstracts were carefully coded and analysed in great detail using Nvivo 10. When doubts about the relevance or coding of the abstracts surfaced, the two authors discussed the abstract, decided on the best coding and documented what was learned from the discussion in a shared document.

Table 1: Applied search string

effect* OR transfer* OR applica* OR impact OR outcome*(search title)
AND
"e-Learning" OR e-Learning OR online OR web-based OR "web based" OR technology* OR WBT OR WBL OR blended OR Internet OR Distance OR CBT OR CBL OR distance OR Computer OR mobile OR simulation* OR "social media" OR "community of practice" OR game* OR gamification* (search title)
AND
learning OR training OR education OR development OR "competence development" (search title)
AND
adult OR "competence development" OR lifelong OR profession* OR employee* OR worker* OR "further education" OR master OR business* (search abstract)
NOT Children OR Child OR kids OR Youth OR "Technology transfer"(search anywhere)

Before the coding began, a rough coding scheme was created based on the research questions, which entailed parent codes (named 'nodes' in NVivo) such as 'definition of effectiveness', 'research question', 'research methodology', 'subject area', 'audience', 'theories applied', 'technology applied', ' key findings' and so on. The detailed coding tree was created through in vivo coding, a grounded approach in which codes are added as the analysis reveals relevant factors by using the original statement of the source as a code name (Harry, Sturges and Klingner, 2005). New sub-nodes were continuously created as new definitions, new factors of effectiveness and new technologies were discovered in the abstracts.

As mentioned, the purposive sampling led to a strategic randomised approach for selecting papers from the large collection. The papers were not investigated in alphabetical order. Rather than analysing from A to Z, a variety of letters in the alphabet was chosen, as there tend to be surnames, and henceforth letters, which are used more in some regions than others. Though the aim was not to obtain an even global distribution of papers, the authors, nevertheless, tried to accumulate the broadest scope of information possible.

Of the 224 abstracts that were carefully read, 111 fulfilled all the criteria and were coded in detail using the above-mentioned method.

1.2 Empirical study – bringing context into the literature study

The empirical study aimed to discover if, how and why an e-Learning program would be successful in improving science teachers' work practice in Danish elementary schools. Thus, the empirical study lives up to the criteria of the literature study, as it focuses on the effectiveness of e-Learning for working professionals. It also explores some of the challenges highlighted by the literature study.

The solution and learning design focused on developing competent teaching methods for natural science. In this project, effectiveness is understood as the transfer of learning, which positively impacts teaching practices. The e-Learning was investigated thoroughly from February to June 2014 as a possible solution for 7 teachers at three Danish elementary schools.

The data gathering method included extensive in-class video recordings and observations. The researcher recorded teaching methods using a mobile ethnographic approach; the teachers had small camcorders attached to their necks, which enabled the researcher to view the classroom from the teachers' perspective. The data consisted of approximately 120 hours of in-class video recordings and 100 pages of observation notes. The researcher also had reflection sessions with the teachers before and after the introduction of e-Learning. These sessions were inspired by the mind tape and retrospective interview methodologies (as in Kumar, Yammiyavar and Nielsen, 2007). The teachers' interactions with e-Learning, including their preparation for classes, were recorded by Camtasia, a software program that can record the screen, mouse movements and a picture-in-picture setting of the user. Here, the think-aloud approach was applied (Nielsen, Clemmensen and Yssing, 2002). The data consisted of approximately 25 hours of video recordings and 40 pages of observation notes of teachers' interactions with e-Learning. The teachers responded to a satisfaction survey immediately following the conclusion of the e-Learning, as well as a pre-survey shortly before initiating the e-Learning and a post-survey approximately one month after completion of the e-Learning. The latter was repeated 6 months after completion. This final data consists of 28 responses to the surveys, which each had approximately 20 questions.

The approach to gathering empirical data was specifically designed to capture some of the complexity, possibilities and challenges of teaching practices, both expected and unexpected. In the following section, the preliminary results of the empirical study are included when they contribute to answering the research questions of this paper.

2. How is the effectiveness of e-Learning defined?

Approximately one-third of the abstracts in the literature study were coded. From these, as many as 19 different ways to define effectiveness have been identified. These definitions are listed in chronological order below, in Table 2, with the most commonly used definition at the top. The table includes 92 papers of the 111 coded. The remaining abstracts did not state the target audience and are therefore not included in this table. The actual number of papers from which the 19 definitions were obtained is 170, not 92. This is because a *set* of definitions is often used to investigate the effectiveness of an e-Learning solution; for example, several papers use both 'learning outcome' and 'satisfaction' as definitions for effectiveness (Harrington and Walker, 2009; Jung et al, 2002; Maloney et al, 2011). The number of papers in this list would of course change if the remaining abstracts were coded, but the author's find that the most common definitions are expected to stay relatively stable, as they have not significantly changed in recently reviewed abstracts.

Table 2: Definitions of effectiveness organised by the context of adult learning

	Higher education	Work-related learning	Total
Number of papers:	52	40	92
Distribution of papers:			
Learning outcome	29	9	38
Transfer (application to practice)	3	15	18
Perceived learning, skills or competency	11	6	17
Attitude	8	3	11
Satisfaction	8	3	11
Skills acquired	5	5	10
Usage of product	4	5	9
Learning retention	4	4	9
Completion	0	5	5
Motivation and engagement	3	2	5
Organisational results	0	5	5
Application to simulated work practice	0	4	4
Self-efficacy	0	4	4

Confidence	1	2	3
Cost-effectiveness	1	2	3
Connectedness	1	1	2
Few errors	2	0	2
Raised Awareness	0	2	2
Success of (former) participants	1	0	1
Undefined effectiveness	10	2	12

Of the papers reviewed, 57 % (52/92) examined effectiveness within higher education, in which context the most prominent definition of e-Learning effectiveness was 'learning outcome', with 56 % (29/52) of these papers applying this definition. Within work-related learning, the most common definition was 'transfer (application to practice)', with 38 % (15/40) of the papers applying this definition.

'Learning outcome' refers to the participants' acquisition of new understandings as a result of the e-Learning initiative. This is a broad definition, but in the abstracts of papers examining higher education, the definition is often clarified in terms of measurements; for example: 'Student learning measurements included: pre-test, final examination (post-test) and final letter grade' (Boghikian-Whitby and Mortagy, 2008).

Within the field of work-related learning, the ability to apply the content or processes of the e-Learning solution is essential. For example, in a study on teachers' technology competencies, it was not 'knowing about', but rather the actual 'integration of computer activities with appropriate inquiry-based pedagogy in the science classroom' that determined effectiveness (Angeli, 2005).

It is, however, interesting that 'transfer (application to practice)' is sometimes evaluated through the participants' self-assessments: 'Outcomes were measured across levels 1 to 3 of Kirkpatrick's hierarchy of educational outcomes, including attendance, adherence, satisfaction, knowledge and self-reported change in practice' (Maloney et al, 2011) and 'A follow-up questionnaire showed that two-thirds of those who viewed the program had subsequently reviewed the performance data for the initial wire they were using and 20 % had changed it' (Marsh et al, 2001). This brings to light the discussion of whether or not it is possible for learners to assess their own transfer (i.e. if people accurately report their actions, or if researchers, managers, peers or learning professionals must observe and report).

Some papers investigated the interrelatedness of more aspects of effectiveness, such as the relation between learning outcome/retention and behaviour. For example, Hagen et al (2011) found that '…the effects of the intervention on security

awareness and behaviour partly remains more than half a year after the intervention, but that the detailed knowledge on information security issues diminished during the period.' Such a study challenges the idea that behaviour changes can be measured through learning retention.

Table 2 also shows that the abstracts dealing with higher education operated with few definitions other than 'learning outcome', while the abstracts dealing with work-related learning generally applied a greater variety of definitions. This could be because universities work with performance requirements that primarily focus on examination grades and completion rates, causing effectiveness to be measured by cognitive knowledge indicators. In a work-related setting, however, effective learning is much broader, including aspects that are not bound to individual or group projects, such as the application of learning to work contexts, organisational results and cost-effectiveness.

It became clear in the analyses that many abstracts and a number of papers did not state their definitions of effectiveness; 13 % (12/92) of the abstracts left effectiveness completely undefined.

1.1 Why is this important?

Having multiple ways of understanding the effectiveness of e-Learning allows professionals and researchers substantial flexibility in defining, measuring and determining the effectiveness of an e-Learning solution. However, the broadness of the concept does present challenges. Leaving the concept of e-Learning undefined may lead to misunderstandings, and the aspects of effectiveness that are of most value to participants and stakeholders may not be considered. Illuminating the many definitions of effectiveness can lead to reflection and inspiration for appropriately utilising the concept of effectiveness, thus enabling learning professionals to better align their expectations and target their measuring efforts towards what is important to them and their stakeholders.

3. How is the effectiveness of e-Learning measured?

The previous section broadens the understanding of the definitions applied within research examining the effectiveness of e-Learning. But how are these definitions investigated in the various studies? How do the researchers measure effectiveness, and with what consequences? Of the 111 abstracts coded in detail, 63 abstracts identified their research design.

Table 3: Research study methods

	Mixed	Qualitative	Quantitative
All abstracts coded with…	9	5	37
Comparative studies applying…	0	1	18

The first row of Table 3 shows the distribution of research studies coded as mixed, qualitative and quantitative studies. In addition, 30 comparative studies were found, 11 of which do not describe in the abstract whether they are conducting qualitative, quantitative or mixed methods research. The distribution of the rest is shown in the second row. Nearly 73 % (37/51) of the studies are quantitative. Almost half of these are comparative studies, which compare e-Learning with traditional face-to-face and/or blended learning. The vast amount of comparative quantitative studies may be due to policy makers' interest in this research (Grgurovic et al, 2013).

The literature study reveals that the most common way to measure effectiveness is through quantitative pre- and post-testing. To come to an understanding of which definitions of effectiveness are most used in particular kinds of studies, the effectiveness code was correlated with the research methods applied. This correlation showed that 'learning outcome' was used more frequently in quantitative studies (18 papers) than qualitative (2 papers) and mixed methods studies (1 paper). More quantitative studies were identified than qualitative studies, but the quantitative studies' use of 'learning outcome' is still significantly higher.

It might be assumed that qualitative studies would use several definitions of effectiveness, but this was not the case. Instead, these studies tended to use only one or two of the 19 definitions, whereas quantitative studies used significantly more. This could be because qualitative and mixed methods studies aim to explore a single concept in depth, and the intentions are often to understand the 'why's' of such a concept, which requires a significant amount of time and resources. On the other hand, quantitative research uses definitions as a set of variables constituting effectiveness, thus necessitating the use of several definitions.

The reason for the distribution of research methods in this literature study could be due to both a publication and policy bias. Writing thorough descriptions of the 'why's of qualitative research requires more space than reporting means and standard deviations. Very few journals allow for such prolonged papers, and quantitative papers also tend to be in higher demand, in line with what Grgurovic (2013) calls a 'publication bias' (i.e. the tendency to only publish studies with statistically significant findings).

3.1 Why is this important?

As stated, most research into the effectiveness of e-Learning focuses on measuring if and/or which e-Learning solutions are effective using quantitative measures. The aim of the empirical study examining an e-Learning program for science teachers was to understand the complex approaches used, when attempting to change teaching practices using e-Learning. The solution uses an on-the-job learning approach, including in-class practice, and a facilitated team-based competence development

setup. It was shown that great effort is needed to use e-Learning to improve teaching performance.

The qualitative analysis of the teachers' interactions with e-Learning (Camtasia recordings) shows three prevailing strategies that the teachers use seemingly to avoid substantial changes to their work practice:

1. Finding statements to reject content, which means that the teachers seemed to be searching for single statements in the e-Learning content that they could use to prove that application to practice was not possible. Some stated that they preferred to teach as the e-Learning suggested, but their work context would not allow for it.
2. Modifying content to make change less demanding, which means that the teachers consciously or unconsciously modified the content to work similarly to their current practices, allowing them to state that they were already teaching this way, or changing the content to become easily applicable. This finding is in line with Bransford and Schwartz (1999), who discovered that people often modify a transfer situation until it becomes similar to something they know (Lobato, 2006).
3. Pinpointing content that can be easily implemented, which means that the teachers used elements of the content that they could easily apply to their teaching without changing it fundamentally.

For the quantitative and qualitative surveys, the teachers were asked to evaluate their application of the program's learning content to the lessons that were observed by the researcher. This enabled the researcher to compare the teachers' self-assessments of transfer and transfer-related concepts (motivation, knowledge and self-efficacy) with the observation material. This led to the conclusion that all teachers following the program made noticeable changes to their teaching practice, largely using the third strategy mentioned above.

This research design (see 1.3) also enabled the researcher to discover unintended and unexpected transfer. For example, one teacher became so fond of her new way of posing questions to the pupils that she now uses the method when teaching history as well. On the other hand, her co-worker was insecure with the new teaching methods, which negatively affected her teaching. Research examining the transfer of learning shows that the traditional notion of one-to-one transfer from learning to practice must be challenged (see Lobato, 2006). A challenge often faced when evaluating effectiveness is that unexpected transfer, which can have both positive and negative impacts on performance, may not be analysed if only known and a priori concepts are investigated. Thus, if only quantitative survey data was gathered, the empirical study would have presented a misleading view of the transfer of learning. In addition, the teachers generally overestimated themselves in both pre- and post-testing. However, by including the qualitative elements of the survey (e.g.

teachers describing their actions during the lessons in their own words), most discrepancies between self-assessment and observation were clarified. The amount of pure quantitative research in the literature study was also of concern. Results relying solely upon rating scales and multiple-choice tests can easily become misleading. Openness to participants' own unframed understandings, even if only part of a survey, can potentially result in more valid and usable answers regarding the effectiveness of e-Learning, regardless of its definition.

4. What makes e-Learning solutions effective?

All the abstracts used in this study were coded for whether the e-Learning was effective, not effective or partly effective, provided this was stated or indicated in the abstracts. This was the case for 61 of the 111 abstracts examined. The distribution is shown in Table 4.

Table 4: Is e-Learning effective?

Effective	41
Not effective	6
Partly effective	14

Considering the challenges of e-Learning, the fact that only 10 % (6/61) of the studies are classified as 'not effective' questions the validity of the classifications. Taking a closer look at the abstracts, it became clear that many of the empirical studies on effectiveness were conducted by researchers who appeared to have a stake in the success of e-Learning. This issue of 'effectiveness bias' means that the literature study at this point does not support the investigation into which e-Learning solutions are particularly effective. Perhaps a future analysis of the papers in question is warranted. What this study can explore are the factors that influence e-learning effectiveness.

A qualitative view of the factors, which the researchers classify as either promoting or prohibiting e-Learning effectiveness across a spectrum of definitions, methodologies and e-Learning media, provides valuable additions to e-Learning design and research. Through in vivo coding, 34 factors were found and divided into the three categories: individual (subject), contextual scaffolding (context + object) and e-Learning solution and process (artefact). These categories are inspired by the concept of activity theory, as they relate to learning and the transfer of learning (in line with Engestrôm, Leont'ev, Vygotsky and Orlikowsky).

Table 5: Factors that influence effectiveness

E-Learning solution and process (artifact):	**Individual (subject):**	**Context scaffolding (context + object):**
Active learning	Age	Learning environment
Applicable to practice	Entrance scores	Support
Balance between asynchronous and synchronous activities	Experience in profession	Technological resources available to user
Cognitive load	Language (second language)	Time available to learn
Collaboration	Learner characteristics	
Communication	Learner preferences	
Computer playfulness	Locus of control	
Design	Motivation	
Instructional scaffolding	Expected workload	
Interaction (learner – instructor and peer2peer)	Perception of learning	
Learner control	Previous e-Learning experience	
Modeling	Previous training	
Problem-based learning	Prior online experience	
Practice (incl. case study, case-based learning, and simulation)		
Structure		
Technological constrains		
Usability		

The categorization of the factors shows an interesting distribution (Figure 15). The papers examined in the literature study clearly prioritise factors related to the e-Learning solution and process, even though contextual factors may be more critical to e-Learning effectiveness (Noesgaard, 2014). The reason for this phenomenon may be that the contextual factors are perceived as too complex and changeable to investigate and control for research, and that they lay outside the responsibility of learning professionals.

As previously mentioned, the grounded approach uses the wording from the papers in the first round of analysis. This was also done for the factors listed in Figure 15. In the second round of analysis, the authors found that the interconnectedness of the factors called for further categorisation. This categorisation into key factors is discussed further below and is illustrated in Figure 2.

Overall, in terms of the contextual factors, the key factors are quite clearly ‘resources’ (time, technology) and ‘support’ (from managers, IT personnel or peers) in the learning environment. These factors are essential for using e-Learning initiatives to improve performance and change behaviours.

With regards to individual factors, the papers generally agree that effectiveness varies according to individual differences (e.g. Armatas et al, 2003; Aydoğdu Karaaslan, 2013). Some papers refer to learner characteristics broadly and others discuss particular issues relevant to their study. Two mentioned characteristics are ‘age’ and ‘previous online experience’ (Figure 15). One study suggests ‘…that adult students benefit more from taking online classes compared to traditional age students […] and that computer competency helped improve performance in online

classes over time' (Boghikian-Whitby and Mortagy, 2008: 107). Sometimes, factors that are not mentioned can have an impact on effectiveness: 'However, although gender is a significant predictor in traditional classroom courses, its effect disappears in Web-based courses. There is evidence that Web-based courses can be conducive to the leaning process of technical knowledge for female students' (Lam, 2009).

The individual factors largely fit into two categories related to learner characteristics: 'experience' and 'motivation'.

It is not surprising that the experience of participants, in terms of previous relevant work experience and online experiences, affects the effectiveness of e-Learning. These factors seemed to determine the kind of attitude that participants 'go into the learning process with'; previous experience can be beneficial, if the previous work and online experiences correspond with the e-Learning (Boghikian-Whitby and Mortagy, 2008; Bennison and Goos, 2010; Haverila, 2010). What is intriguing is that, experience may either increase or decrease effectiveness. The authors have in previous empirical studies within higher education with students who study IT and educational design found that, when the definition of effectiveness was 'satisfaction', the students' previous experience with a variety of e-Learning solutions left the students unimpressed; hence, decreasing effectiveness (satisfaction). In the empirical study discussed in this paper, the teachers had little e-Learning experience and were generally satisfied. Similarly, a learner with significant relevant work experience may perform well on tests and at work but have a low satisfaction score because the learning was not challenging. This underlines the importance of clarifying the definition of effectiveness and to discuss the ways in which individual factors can affect effectiveness.

Motivation to learn and engage with the e-Learning solution is key to effectiveness, especially when effectiveness is defined as the time spent using the product: 'Results suggest the importance of motivation to learn and workload in determining aggregate time spent in e-learning courses' (Brown, 2005: 465). However, when projects are defined as 'blended e-Learning', time spent may not always be a good indicator of whether learning took place: 'beyond the impact of extrinsic-related perceptions, social and personal motivations are important drivers of discussion forum usage in an e-learning context…[] … It is concluded that even for adult learners, social interaction with instructors and collaborative interaction with peer students are important in enhancing learning and active participation in online discussion' (Jung et al, 2002: 153). Therefore as in traditional learning, motivation is not only based on individual factors.

For the e-Learning solution and process, the key factors are 'interaction' and 'practice'. The importance of these factors was determined as a result of the coding of the factors that influence effectiveness as well as the codes including the reasons that e-Learning was or was not effective. Interrelated factors, such as 'instructional

scaffolding', 'modelling' and 'support', were combined into a single factor, 'interaction'. Though e-Learning is often considered to be equally or more effective than face-to-face learning, interaction is generally considered to be critical to the effectiveness of e-Learning, as illustrated in the following papers: 'Students valued interaction with instructor as an important factor in online learning. New students had a better success rate in instructor-led online courses than in independent-study online courses. Adult students need modelling and scaffolding to be successful in an online environment' (Jiang, Parent and Eastmond, 2006); '…the supported training group had a significantly higher program completion rate than the independent group' (Bennett-Levy et al, 2012); and 'Results indicate teachers attributed improved student learning to technology use; online communication with peers and experts reduced teacher isolation, enhanced professional practice and gave access to perspectives and experiences otherwise unavailable; but the additional workload discouraged several teachers' (Hawkes and Good 2000). The last article also touches on the contextual factors as it emphasises the need to consider both the time available to the learners and the expected workload of the e-Learning (see also Noesgaard, 2014).

A recurring factor contributing to e-Learning effectiveness is 'practice'. The learner is given the opportunity or is required to practice the educational material presented via the e-Learning solution in case studies, simulations or actual work situations. The aim is to support learning retention and transfer to practice, as simulated practice provides a safe learning environment before the skills are applied in critical work situations: 'Intermediate-fidelity simulation is a useful training technique. It enables small groups of students to practice in a safe and controlled environment how to react adequately in a critical patient care situation. This type of training is very valuable to equip students with a minimum of technical and non-technical skills before they use them in practice settings' (Alinier et al, 2006).

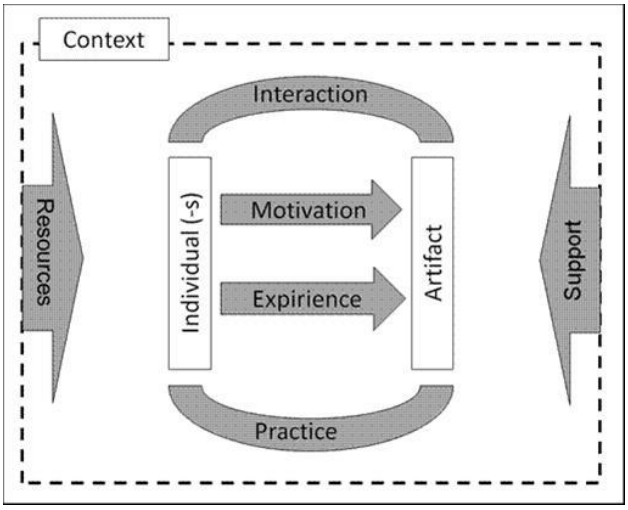


Figure 2: Key factors influencing effectiveness

The model in Figure 2 shows the key factors (in grey) that were identified by the review to influence the effectiveness of e-Learning (artefact) across the multiple definitions (Table 2). A supportive and resourceful learning environment (context) must be in place. The level of motivation of the individual(s) interacting with e-Learning (artefact) influences the time they spend using the product, and previous online or professional experience appears to have a largely positive impact on effectiveness. An e-Learning design that accommodates interaction between instructor(s) and peers and provides opportunities to practice the e-Learning material in simulated—or, when appropriate, real-life—work situations also promotes e-Learning effectiveness. As such, this model shows the interrelation of the key factors influencing effectiveness, but it cannot stand alone, as this abstraction like many papers in the literature review does not take the great variety of definitions into account. However, it is a good tool for starting discussions about effectiveness.

4.1 Why is this important?

Understanding the factors that are deemed critical for effective e-Learning in the context of adult learning can enable learning professionals to reflect on their priorities regarding learning design. The model and list of factors can be used as a checklist and a starting point for discussing how to ensure that the factors relevant to specific e-Learning participants, contexts and solutions are taken into account.

5. Critical reflections

Many of the studies analysed in this integrative review value e-Learning based on how well a given e-Learning solution accommodates for individual characteristics (experience and motivation) or the extent to which the solution provides opportunities for interaction and practice and to a smaller extent whether or not the necessary contextual resources and support are in place (Figure 2).

As discussed, approximately half the papers included in the literature review use a comparative methodology. This means that the effectiveness of e-Learning is largely defined based on how well the e-Learning performed, compared to traditional face-to-face teaching with the same content. Thus, the same definitions of effectiveness are used for both e-Learning and face-to-face teaching, and e-Learning must outperform face-to-face teaching in order to be considered effective. With this in mind, it becomes important to take another critical look at the key factors, since the comparative research methodology affects their perceived importance. This means that some of the factors like interaction and practice may have surfaced as critical during the review, because these factors illustrate the strong sides of face-to-face teaching. A given e-Learning solution must, therefore, entail these factors to be effective when compared to face-to-face teaching. But do we want e-Learning to be more like face-to-face teaching? Is the most effective e-Learning an online replication of the classroom setting? What would happen if policy makers and researcher stopped asking if e-Learning is as good as what we currently have with face-to-face teaching and instead started asking if we could get something better or different from e-Learning? Should different modalities have the same measures of performance, or should we consider e-Learning to be a unique learning process and thus use different definitions of effectiveness?

Within recent years, massive open online courses (MOOCs) have received profound attention within the field of e-Learning. MOOCs offer free courses, competence development and even certification. They are often considered to be the promised land of education, democratising education through scalable technology. As a stand-alone solution, MOOCs provide opportunities for reflecting on and constructing new knowledge, but often they entail a minimum amount of live interaction. Many MOOCs continue to be online replications of classrooms primarily consisting of video lectures, multiple-choice quizzes, Q&As and more informal after-class discussions in online discussion forums.

So are MOOCs ineffective because little interaction is provided compared to face-to-face teaching? And if not, is interaction not a key factor in e-Learning effectiveness? We argue that interaction is indeed essential to learning retention and the transfer of learning. An educational design applying collaboration and interaction with peers and a facilitator (the teacher or instructor) can provide a purposeful space for reflecting on the practice as well as an empathetic customisation of the subject

matter, which no automatic process is capable of yet. Hence, when the overarching objective is to design e-Learning which increases learning retention and work performance, the effectiveness of e-Learning may very well be evaluated by the quality of the interaction provided. But what if the overarching objective is different than the definitions provided here (Table 2)? What if we, despite the vast number of definitions in this paper, are missing more e-Learning specific definitions that are independent of face-to-face teaching, such as democratization and scalability? And as a last mental exercise, what would happen if we started evaluating face-to-face instructions on these objectives?

6. Conclusions

This paper has discussed the following research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective?

Through an integrative review, relying on both a literature review and an empirical study, this paper identified multiple ways to define effectiveness, with 'learning outcome' as the most prominent definition. The authors highlighted the benefits of reflection on and clarification of the way in which these definitions are used in research and practice. The paper discovered that the research is largely applying quantitative and comparative methodologies. In this regard, this paper suggests that applying purely quantitative measures to fulfil predefined learning objectives does not allow researchers and practitioners to discover unexpected and unintended transfers to practice and presents potential sources of error. Including open-ended qualitative questions in surveys can substantially improve the validity of such approaches; the empirical study and some of the analysed papers show that self-assessment can give researchers and designers quality feedback on the effectiveness of the e-Learning solution. To understand what makes e-Learning solutions effective, this paper analysed factors promoting the effectiveness of e-Learning. These factors were categorised according to the context in which the e-Learning solution was used, the artefact (the e-Learning solution itself) and the individuals that used the artefact. Subsequently, further categorization into key factors resulted in a model to guide e-Learning design.

One of the many questions raised in the discussion was the question of whether e-Learning and traditional face-to-face learning should be measured based on the same definitions of and approaches to effectiveness. To find appropriate answers to this question, the authors suggest that future researchers and designers critically consider the identified definitions, measures and factors when designing for effective e-Learning.

7. Limitations and further work

The literature study has certain limitations: First, the fact that the analysis is based primarily on abstracts, only including a few full papers, might have resulted in slightly different categorisations than had the full papers been analysed. Second, e-Learning is dealt with as a single concept, when in fact it consists of a great variety of delivery methods, technologies and learning designs. However, these variations are coded in the literature study, and the authors look forward to further exploring the concept of e-Learning. Third, the literature study considers a larger number of papers than most other literature studies. Still, the quantitative analysis will benefit from an increased number of coded abstracts since some of the findings are based on relatively small numbers (Table 2). However, as mentioned in the methodological section, the authors chose theoretical saturation over volume. Finally, both researchers were involved in discussions about the design of the e-Learning solution tested in the empirical study and thus may be affected by effectiveness bias. The researchers will continue to explore these concerns as the study continues.

8. Recommendations

Based on the analyses in the previous chapters, the following recommendations are proposed:

- There are many understandings of e-Learning effectiveness. Be sure to clarify what would make your solutions effective. Consider using the list of definitions for inspiration (Table 2).
- Do not measure effectiveness simply for the sake of measuring. Know what measurements will give you the documentation your stakeholders require and the answers you need to continuously improve your solutions.
- When designing e-Learning, consider the key factors that impact e-learning effectiveness (Figure 2).
- Be critical and consider whether or not your face-to-face and e-Learning solutions should use different definitions of effectiveness (performance measures). Aim to compare your solution to other solutions using the same definitions of effectiveness.

Acknowledgements

This research is part of an industrial PhD project funded by the Danish Ministry of Higher Education and Science in partnership with the Kata Foundation.

References

References can be found in the dissertation's literature list.

2.2. FURTHER DISCUSSIONS OF FINDINGS

This section briefly readdresses those key findings from the literature review in Article A that are of special relevance to the dissertation's research questions. Specifically, the section highlights topics and gaps in the field that are critical to further investigation of the effectiveness of oPD in advancing work practices.

2.2.1. A QUICK UPDATE

In January 2015, another database search was conducted using an identical search string. After shortlisting the search results to include only empirical studies on the effectiveness of e-Learning in adult domains, 117 new articles were added to the project. The in-depth analysis conducted in Article A has not yet been completed for the new studies, but the studies appear to confirm Article A's findings in terms of definitions and methodologies. In addition, the publication of 117 relevant articles from October 2013 to January 2015 confirms that the number of research articles examining the effectiveness of e-Learning is still increasing (see Figure 1a in Article A, Section 2.1).

2.2.2. MATCHING DEFINITIONS AND METHODS

The literature study highlighted the criticality of not only defining effectiveness but also scrutinizing the definitions and methodologies applied in order to understand their adequacy for attaining the most valuable information for oPDI stakeholders. If, for example, effectiveness of an oPDI is defined by a specified change to teaching behaviors, teacher satisfaction with course content may not yield adequate information for decision-making and redesign of the intervention. Such concerns are further discussed with the empirical data in Chapter 8.

2.2.3. FOCUSING ON PROFESSIONAL DEVELOPMENT

This dissertation rests within the field of oPD. In Article A, this field is called work-related e-learning, which is to be understood as synonymous with oPDI. With the focus on advancing practices through positive alterations in work behaviors, the articles that define oPDI effectiveness as "Transfer (application to practice)" are of special interest. As stated in Article A, this is also the most-used definition among the oPDI articles included in the study (Article A, Section 2.1). The factors influencing effectiveness (Table 5 and Figure 2 in Article A, Section 2.1) were established through coding of articles within higher education as well as PD. The definition of effectiveness most often applied when looking at articles from both fields was "learning outcome." Hence, the key factors influencing effectiveness do not necessarily refer to effectiveness as behavior change or as an advancement of professional practices. Chapter 5 will discuss the literature that specifically addresses this transfer of learning to practices and will examine the importance of the contextual factors of the literature study.

2.2.4. ONE INTERVENTION – SEVERAL DEFINITIONS OF EFFECTIVENESS

Understanding the different definitions of effectiveness that may be applied to a single oPD intervention became increasingly important in the PhD study. Different stakeholders may not only have different formalized definitions of effectiveness but may also have different perceptions regarding when effectiveness is achieved. The three oPDI stakeholder positions (oPDI initiator, practitioners, and researcher) are explicated theoretically in terms of effectiveness in Section 3.2 and empirically in Sections 6.1 and 9.1.

2.2.5. EFFECTIVENESS BIAS

The term *effectiveness bias* was coined in Article A. This term highlights the tendency to focus on those consequences of an oPDI that can bear witness to its effectiveness. It also brings perspective to the question of the extent to which oPDIs are effective. As an example from one of the studies included in the literature review, March et al. (2001) concluded the following in their study on the effectiveness of an oPD program for orthodontists that provided information about specific wires used in orthodontic treatment:

> A follow-up questionnaire showed that two-thirds of those who viewed the program had subsequently reviewed the performance data for the initial wire they were using and 20% had changed it, so the computer program was effective in changing clinical behavior.

When is oPD effective? When two-thirds do something different? When 20% does something different? In order for the statement "was effective in changing clinical behavior" to hold true, only one participant would have to change something that could be ascribed to participation in the oPD. Without a specific, agreed-upon target, the extent to which an oPD is effective is largely a matter of interpretation. One might also question whether an intended change in behavior is necessarily an advancement of practice. Section 3.1.1 elaborates on this discussion with insight from the philosophical approach of pragmatism.

2.2.6. A DIFFERENT APPROACH

The methods used to investigate the different definitions of effectiveness were brought into question in Article A. The study discovered a lack of qualitative empirical research on the effectiveness of online PD in advancing work performance. Interestingly, this is also the case within TPD – a field which, compared with other arenas of professional development, highlights the difficulties in achieving TPD-based advancements to teaching (Bill & Melinda Gates Foundation, 2014; TNTP, 2015). The literature review specifically pointed to a risk of missing out on important

unexpected and unintended aspects to the effectiveness of oPD by applying purely quantitative comparative methods with predefined objectives (Noesgaard & Ørngreen, 2015).

In addition, Article A's categorization of the factors influencing e-Learning effectiveness showed that the contextual factors appeared to be de-prioritized as the point of investigation, possibly due to the complexity of lived practices (Noesgaard & Ørngreen, 2015).

In contrast, the PhD study addresses these gaps in extant research, as its qualitative, empirical research primarily focuses on contextual factors and the complexity of work practices; this in order to allow for the unexpected and unintended.

CHAPTER 3. PHILOSOPHY OF SCIENCE

Different philosophies of science make different claims about "what knowledge is (ontology), how researchers obtain knowledge (epistemology), what values go into it (axiology), how we write about it (rhetoric) and the process for studying it (methodology)" (Cresswell, Plano-Clark, Gutmann, & Hanson, 2003, p. 6).

This chapter introduces the ontological and epistemological perspectives that serve as the broader philosophical frame of the PhD project. Naturally, the epistemological and methodological perspectives are heavily intertwined. Nevertheless, the specificities of the methodology and research methods applied are tied to the empirical case and are therefore presented in connection with the case in Chapter 4.

The ontological and epistemological foundation of the PhD study combines the views of classical pragmatism with contemporary social constructionism. These two paradigms share basic views and values, enabling them to form a coalition. Importantly, pragmatism lends social constructionism a way out of the potentially paralyzing de-construction, and social constructionism lends pragmatism a contemporary superstructure and learning theory. In addition, situated learning theory became a critical explanatory frame for the empirical findings of the PhD study.

3.1. PRAGMATISM: EFFECTIVENESS IN TERMS OF PRACTICAL DIFFERENCES

The overall objective of the PhD project was to investigate the effectiveness of oPD as evidenced by the practical consequences of oPD interventions with regard to advancing work practices. As such, the dissertation research shares the core view of classic pragmatism in its aim to validate research by tracing its "practical consequences" (Hookway, 2016). William James, a leading figure of classic pragmatism states that "The whole function of philosophy ought to be to find out what definite difference it will make to you and me, at definite instants of our life, if this world-formula or that world-formula be the true one" (James, 1907, p. 3). William James goes on to explain,

> There can *be* no difference anywhere that doesn't *make* a difference elsewhere—no difference in abstract truth that doesn't express itself in a difference in concrete fact and in conduct consequent upon that fact, imposed on somebody, somehow, somewhere and somewhen. (James, 1907, p. 3)

With *effectiveness* in this dissertation defined as the extent to which oPDIs influence practices positively, the practical consequences of oPDIs become both the subject matter of the PhD research and the validation criteria for the research conducted.

In line with James' pragmatism, the PhD research aims to understand concepts and complexities of oPD by showing how they are used and how they exist in lived work practices. The aim is not to accurately describe universals of PDIs and contexts; rather, the goal is to investigate variation and individual learning trajectories to generate frames of explanations and design theories that aim to make a difference.

In pragmatism, the philosophical assumptions about what constitutes knowledge are linked to an understanding of "truth." Rather than trying to identify the essence of truth, they try to describe the role of "truths" in our practices. "True propositions are ones that enable us to function well, that function well as instruments" (Hookway, 2016, p. 14). This also applies to theories used, which should thus be valued according to their adequacy as functional instruments that assist us in reaching the aim of our research (James, 1907). Consequently, this dissertation is built on the pluralistic view that there can be different truths, and realities are only "what they are known as" (James, 1907, p. 3). As such, knowledge is a combination of "truths" and experiences that solve practical problems.

Similarly, the impetus of social constructivism is to point out historical and cultural biases in claiming scientific objectivity by pointing out that knowledge is socially constructed. Both paradigms display an aversion to rationalism, and "in each case there is an attempt to move beyond the intellectual quagmires of the time" (Hastings, 2002, p. 716).

> For the rationalist, "the operation of inquiry excludes any element of practical activity that enters into the construction of the object known." For the pragmatist, the needs of practice are allowed to contribute to the construction of objects. (Hookway, 2016, p. 17)

Over time, we have come to assume that the best research reflects no researcher and results are quantitative and untainted by the exigencies of experience and the contingencies of practice. This dissertation takes issue with that approach, instead viewing knowledge as embedded in and inseparable from practice and experiences. Thus, practice is not only *allowed* to interfere with research results, it unavoidably will.

In terms of inquiry, the PhD project, inspired by pragmatism, rests on the belief that scientific investigation is accomplished through specific empirical interventions in those practices we are seeking to influence. Pragmatism is generally open to exploring the various methods employed across a variety of sciences.

> She will entertain any hypothesis, she will consider any evidence.… Pragmatism is willing to take anything, to follow either logic or the senses, and to count the humblest and most personal experiences. (James, 1907, p. 12)

As such, this research project's inquiry is practical and pragmatic in that it employs paradigms and methods considered most appropriate to the problem researched and to result in a difference that makes a difference.

3.1.1. A DIFFERENCE THAT MAKES A DIFFERENCE

Though the origin of the phrase "a difference that makes a difference" is a matter of debate, Bateson (2000) is often credited with describing the "elementary unit of information" as "a difference that makes a difference":

> When you enter the world of communication, organization, etc., … you enter a world in which "effects" … are brought about by *differences*. That is, they are brought about by the sort of "thing" that gets onto the map from the territory. This is difference. (Bateson, 2000, p. 452)

Difference can be interpreted as a "thing" that surfaces from the sea of all other "things" by being ascribed with value. In its elementary sense, the word *idea* is synonymous with *difference* (Bateson, 2000). Inspired by Bateson's understanding of difference, this dissertation uses the phrase "a difference that makes a difference" to refer to ideas that bring about effects that matter to stakeholders. Stated simply, the dissertation focuses on whether, why, and how oPDIs (differences) *can* change professional behaviors (effects) that *can* make a difference (advancing practices).

The ongoing discussion of stakeholder positions will help steer this rather high-level definition of oPD effectiveness in terms of differences. Additionally, design principles will bring some concreteness to how such difference may be achieved. Design principles that guide the design of the empirical case's oPDI can be found in Section 6.2. Design principles guiding future oPD design can be found in Chapter 13.

3.2. SOCIAL CONSTRUCTIONISM: SOCIAL POSITIONINGS AND SITUATED LEARNING

Social constructionism is a collective denotation for a series of contemporary theories on culture and society. Their common denominator is a rejection of what we have come to think of as natural and indisputable truths. It is a social constructionist premise that knowledge cannot be viewed as reflections of reality "out there"; knowledge is instead a construction that is created and maintained through social processes (Jørgensen & Phillips, 1999). According to Gergen (1994), one of the most prominent representatives of social constructionism, "objective knowledge" is "the

end result of social processes involving a coalition of subjective perspectives" (Hastings, 2002, p. 717). Moreover, human identities are constructed though narratives interchanged in social interaction. We use linguistic narratives to construct a "self" and an identity for ourselves, for others, and as a means to make ourselves comprehensible. Hence, from a social constructionist perspective, narratives are formed and told in social interactions, and our stories vary according to context and relations. Our application of narratives is thus attached to the specific contexts in which we interact (Gergen, 1994). Consequently, our reality is a social construct, and there are no definitive truths – only different narratives about them. Social constructivism assumes that our perceptions and knowledge are determined by social connections and are constructed in social interaction in which shared truths are constructed and truths and their value are negotiated (Jørgensen & Phillips, 1999). "The degree to which a given account of world or self is sustained across time is not dependent on the objective validity of the account but on the vicissitudes of social process" (Gergen, 1994, p. 51).

Social constructionism is anti-realistic and anti-essentialist. Thus, this dissertation does not attempt to uncover objective realities in a realistic sense, nor does it attempt to uncover essential meaning in a phenomenological sense. Instead, it centers on our construction of knowledge in contingent processes and the applications these constructions have for our actions in the world (Burr, 1995). With pragmatism at hand, the implications of oPDIs are the quintessence of the PhD work. Anti-essentialist social constructivism primarily focuses on the constitutive knowledge and "truth" construction and thus on their deconstruction, which by and large makes individual motivations and intentions irrelevant. Sole dependence on a social constructivist framework would have placed the PhD project, which is primarily concerned with the practical consequences of oPDIs, at risk of becoming a linguistic deconstruction of PD practice. The "practical" consequence might then have been limited to encouraging educators and researchers to reflect critically on the "truths," normativity, and subjectification of the field. The "pragmatic" social constructionist approach of the PhD project understands individual motivations, strategies, and intentions as socially constructed, sustained, and changed, but as subjective realities they are considered valid constructs for investigation and discussion. In this regard, the social constructionist approach of the PhD is not radical in terms of denouncing any materialistic reality outside human perception. Instead, it brings attention to our shared as well as subjective *perceptions* of realities and their constitutive powers.

While the extent to which social constructionism has its origins in classical pragmatism is disputable (Robinson, 1993), it has been suggested that William James' pragmatism is the predominant precursor of Gergen's social constructionism (Hastings, 2002). This dissertation is less concerned with tracing a tradition for social constructionism, however, and more concerned with applying pragmatism as a "philosophical method to evaluate the multitude of ideas that emerge within a social constructionist framework" (Hastings, 2002, p. 719). More specifically, a social

constructionist framework can serve to illuminate concepts as social constructs, which in turn highlights the sensitivity and dependencies of social context and interaction, whereas pragmatism serves as a selective philosophical methodology underlining the need for evaluation and validation of findings in light of their utility.

With anti-essentialism, social constructionism is not concerned with the "self" in humanistic terms. On the contrary, the term *subject positions* is applied in order to highlight that what we have come to know as the "self" is largely a "product" of social interactions and relations. The dissertation uses the term *position* to bring attention to the value-laden definitions of effectiveness that may vary across oPD stakeholder positions. Two different levels of positions are in focus in the dissertation: 1) stakeholder positions (oPDI initiator, practitioners, researcher), which serve to highlight differences in definitions of effectiveness from different stakeholder-specific points of view; and 2) practitioners' specific positions, including their divergent negotiations and strategies in defining oPDI effectiveness. These positionings in the social constructionist frame will assist in answering the question of what defines effectiveness of oPD, and according to whom. Chapter 6 initiates discussion on the positions in the empirical case.

3.2.1. THEORY OF LEARNING: SITUATED LEARNING

Learning theories permeate every aspect of this dissertation. In Section 9.2.1, one of the dissertation's articles shows how the co-examination of epistemologically different theories of learning can serve to unfold a concept of teacher frustration. Generally, however, the analysis of empirical data increasingly called for the situated learning perspective to inform and conceptualize the findings; thus, throughout the dissertation articles, situational learning theory is increasingly applied as an analytical instrument for understanding the empirical results. Hence, the reasons for choosing the dissertation's social constructionist frame are largely empirical, though social constructionist perspectives on the transfer of learning also informed the design of the oPDI in the empirical case (see Section 5.1). Situated learning theory has thus been used as an vital explanatory instrument, as James (1907) proclaimed theories should be used.

Situated learning became an increasingly dominant learning theory in the late 1980s and into the 1990s, with Jean Lave and Etienne Wenger as leading figures. Situated learning theory builds on Vygotsky's (1978) constructivism and ideas about scaffolding (discussed further in Section 12.1) and John Dewey's (1963) hands-on learning and experiential education, which called for practice-based learning and reflection. Rooted in social constructionism, situated learning theory reports how learning is present and enabled in the relational specificity of contexts, making the notion of detaching from concrete experience problematic; in short, knowledge cannot be isolated from practice if it is to be meaningfully studied (Beach, 2003; Greeno, Smith, & Moore, 1993; Lave & Wenger, 1991). Lave (1988) does acknowledge some continuity across practices (p. 186), as does the PhD work in its focus on capturing

change, and thus stability, across learning situations. This discussion is extended in Section 5.1 addressing the transfer of learning literature.

Situated learning theory has been viewed as a rejection of the existence of cognitive learning processes and a declaration that learning exists only in relations and interactions. This dissertation instead takes the position that situated learning theory is more a matter of change in perspective relative to cognitivism and constructivism (Paul Cobb, Zhao, & Dean, 2009; Korthagen, 2010); in this context, situated learning neither refuses the existence of cognitive representations of knowledge nor the relevance of individual motivations in learning. Consequently, and in line with the work of most pragmatists, the dissertation deals with a variety of tacit beliefs and mental states (what pragmatists call "habits") of reasoning and acting – for example, strategies in Section 9.1 and frustration in Section 9.2. Situated learning is thus more a matter of perspective in which the constituting power of contexts and interactions is in focus. These and extended perspectives on situated learning theory will continuously inform the findings of the dissertation.

3.3. THE VALIDITY OF KNOWLEDGE

With pragmatism and social constructionism as outsets, this section discusses the validity of research and validation criteria important to the PhD research.

3.3.1. REFLECTIVE PRAGMATISM

The renunciation of a traditional scientific ideal of truth by both pragmatism and social constructionism may lead readers to question the validity of this dissertation's knowledge generation; when statements and findings are not "true" in a traditional sense, what validity do they have? Could other statements and findings be as true as those presented here? What makes these ones scientific? Where is the demarcation line? This inept problem of social constructionist philosophies of science may contribute toward making the deconstruction of socially accepted "truths" the end-goal. With pragmatism, the PhD work does, however, insists that findings be evaluated in the practical consequences of PDIs. A related way of evaluating the validity of qualitative research is to assess whether the analysis has been successful in creating new solutions and explanations (Potter & Wetherell, 2007). Gergen (2014) seems to second this criteria in his statement that "we have been victims, in this sense, of what Chamberlain (2000) calls 'methodolatry', that is, the tendency to give primary attention to one's methods of study over the ends one hopes to achieve" (Gergen, 2014, p. 58). He did, however, caution that research does not merely become a supportive resource to reach a goal: "Inquiry without reflection on what is being favored and for whom is ultimately injurious to the profession and public alike.… All practices of inquiry carry with them values. In their implementation we sustain these values" (Gergen, 2014, p. 58). As Biesta (2007) argued, this implies that research cannot be a matter of generalizing "what works" across professional contexts. Education professionals need to make judgments about what is educationally

desirable and most appropriate under "the specific circumstances in the contexts of informal rules, heuristics, norms and values" (Biesta, 2007, pp. 10–11). This dissertation concurs with Biesta in that educational judgments are by their nature normative judgments. Consequently, educational technologies are value-laden and normative as well. The popularity of testing new educational tools and techniques is, however, not inherently misguided: "Misguidance occurs as researchers get caught in a cycle of research without contemplating the merits of the investigation and the values implied by the tool or technique being used" (Amiel & Reeves, 2008, p. 33).

Gergen (2014) called for a *reflective pragmatism* as an approach to inquiry and evaluation: "Paramount in this case is first the question of whether the supporting practices effectively contribute to the achievement of one's aims, and second, whether there is sufficient reflection on the values being championed and suppressed" (Gergen, 2014, p. 59).

In this dissertation, this reflective pragmatism includes the aim of generating design principles to guide oPDI design; These are intended to contain multiple stakeholders' definitions of effectiveness – potentially also in related domains other than that of the empirical TPD case. With regard to the normative aspects of oPDIs the critical questions to be asked includes not only what constitutes a positive difference, but to whom and at what cost. This depends on the specific intervention and will be discussed for the empirical case in Chapter 6. In providing an explanatory frame for different stakeholder positions and narratives, social constructionism assists in bringing attention to the positionings of stakeholders, which in the empirical case turned out to be critical to differentiate.

3.3.2. VALIDATION CRITERIA

It should be clear by now that this dissertation's qualitative research does not aim to present a quantitative, realist philosophy of science; as such, it neither claims nor attempts to be generalizable and replicable. Instead, research validity should be reconceptualized "in a manner and a language that is appropriate for (…) research within particular paradigms" (Vithal & Valero, 2002). Epistemological and methodological coherence is critical and underlines the importance of not "lending" terms and methodologies from fundamentally different paradigmatic research approaches. More specifically, methodological coherence reflects a congruence between research question and component of the method, which in turn matches the data gathered and the analytical procedures. This includes the acknowledgment that any of the parts may be modified in the research process (Morse, Barrett, Mayan, Olson, & Spiers, 2002). This consequently leads to a reexamination of the other elements of the research process in order to uphold coherence. Vithal and Valero (2002) argued that in situations of constant change such continuous responsiveness and responsibility reflect rigor to a greater extent than "adhering to a predetermined research design" (Vithal & Valero, 2002, p. 580). This is explored further in the methodology sections in Chapter 4.

Gergen also cautioned the application of general criteria across qualitative research traditions. Instead, he proposed applying abstract criteria, which "leave open the possibilities for multiple interpretations, specific to the various traditions of practice" (Gergen, 2014, p. 57). For the PhD work, these criteria include the following questions: Does the research contribute further to our understanding? Is it linked to relevant dialogues in the field? Is it rigorous in design and implementation? Is the writing coherent and understandable? (Gergen, 2014).

Concepts like generalization, reliability, and validity have distinct criteria in quantitative research that are generally inapplicable to qualitative research (Gergen, 2014). Research does, however, "never completely escape generalization. Researchers constantly make judgment of the applicability of others' research to their own research" (Vithal & Valero, 2002, p. 579). In this regard, the PhD research is no exception. In order to discuss and build upon extant research – most of which is quantitative (Noesgaard & Ørngreen, 2015) – statistical educational studies are welcomed as important contributions to the field, but too seldom these studies are viewed as normative construction dependent on the contexts from which they are derived. In the PhD research, such statistical studies have been evaluated and referred to based on the criteria of *generativity,* which refers to the extent to which the results make the reader think of other possible situations in which those results would be relevant. Generativity addresses the issue of *transferability and recontexualization*. It is problematic to assume that results can be transferred to a new context without the object itself being transformed (Cobb & Bowers, 1999; Korthagen, 2010; Lobato, 2006). This is further discussed in Chapter 5 on the transfer of learning.

In sum, the pragmatist and social constructionist coalition makes it possible to investigate some of the contextual complexities that influence the effectiveness of PDIs. Findings will not be generalized, nor will specific content design methods or interactional characteristics be presented as replicable. Instead, the coalition can support a conceptual framework that embraces the continuous construction and situatedness of learning and proposes PDI designs that adhere to this framework, thus rendering possible the extension to other oPD domains.

THE EMPIRICAL CASE

Online Professional Development of Danish K–5 Science Teachers

Chapters 4–11

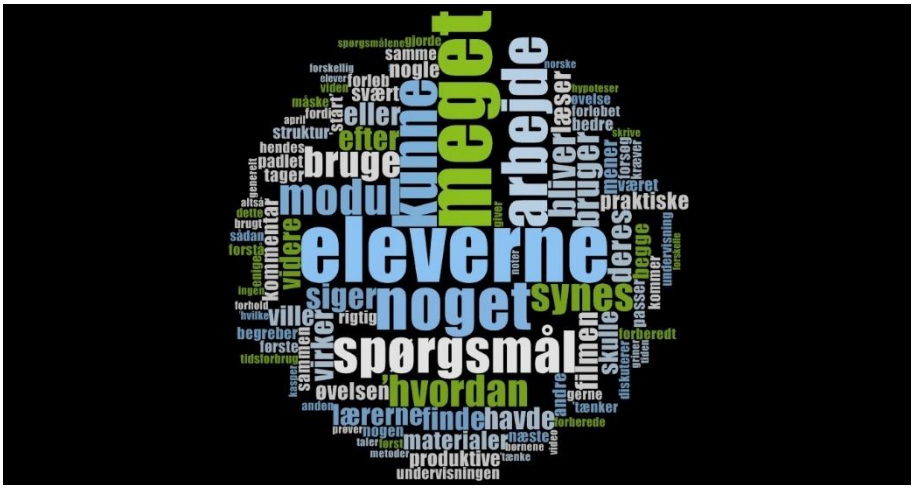


Figure 2: Word Cloud from Teachers' Interaction with the oPD Intervention of the Case

THE CHALLENGE

At the commencement of the PhD project in May 2013, as many as 70% of Danish K–5 science teachers had never received any formal training in teaching science (Undervisningsministeriet, 2009), and a large number of teachers teaching STEM subjects were scheduled to retire within the following 10 years. At year's end in 2012, the Danish government announced an objective stating that by 2020 all students in the Danish public school should be taught only by teachers specialized in the subjects taught (Regeringen, 2012).

At the time, Danish students' performance in the natural and technological sciences (henceforth called *science* when referring to teaching) was relatively high in international comparisons. Students' attitudes toward science were primarily negative, however; they did not understand the essence and value of the subjects of science, and they lacked academic confidence (Aarhus University, 2011). Studies had already established that Danish youth aspired to pursue education and occupations in science-related areas to a much lesser extent than youth in other countries (Egelund, 2007). Moreover, projections suggested that Danish industry would be lacking approximately 13,500 engineers by 2020 (IDA, 2011).

The science teacher and the science teaching have a critical impact on students' achievements and motivation (Egelund, 2010). The teacher and his or her teaching have repeatedly been shown to be the most critical factor for student performance and motivation both nationally and internationally. Hattie (2014) famously created a synthesis of more than 800 meta-studies on student achievement covering more than 80 million students and 50,000 sub-studies. He ranked 138 aspects of teaching. Of these, the contact and interaction between teacher and students is the most influential factor on student performance. According to the study, teachers' teaching behaviors have a greater influence on student achievement than factors such as the number of students in class or the deviations in their performance levels. Understanding the vital role of the teachers, it was a concern that 92% of Danish science teachers perceived a great need for professional development and their participation in professional development was far below the international average (OECD, 2009).

The KATA Foundation, a non-profit project foundation dedicated to improving elementary school science, decided in 2013 to address some of these issues. Aware of the critical impact teachers have on their students, the KATA Foundation found that a TPD intervention was the most effective approach to positively impact science teaching. Specifically, the KATA Foundation wanted to help teachers initiate inquiry-based teaching methods in their classrooms. Despite a limited budget, the KATA Foundation sought to develop a TPD intervention to influence the teaching behaviors of potentially all of Denmark's approximately 6,000 science teachers. The Foundation had a strong innovation profile, and with no structured oTPD programs in Denmark at the time, this was seen as the way to achieve both innovation and scalability. The PhD project commenced alongside the initial planning of the oTPD development.

CHAPTER 4. METHODOLOGY

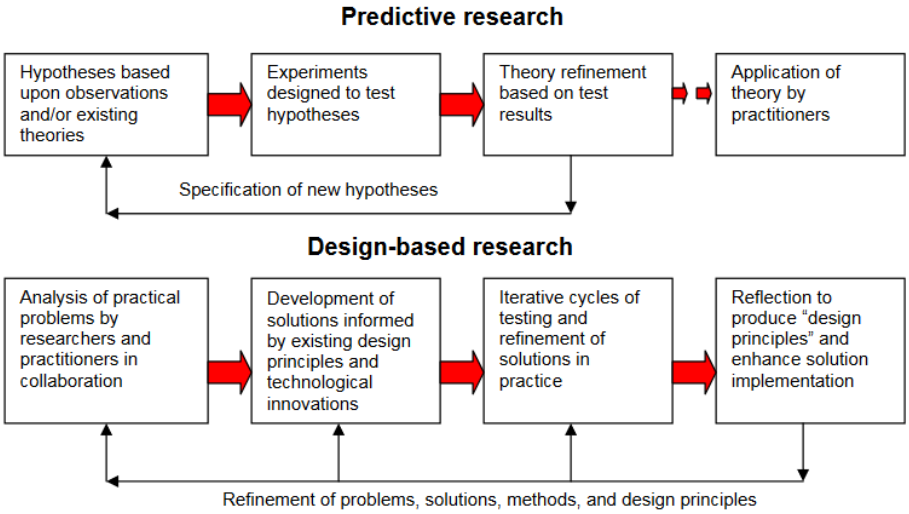
The methodology of the empirical oPDI case is inspired by design-based research (DBR), which, in line with reflective pragmatism, embraces research as a program for continuous iterative reflective work aimed at changing practices: "The ultimate goal of design-based research is to build a stronger connection between educational research and real-world problems" (Amiel & Reeves, 2008, p. 34).

In the PhD study, and in DBR studies more generally, interventions are conceptualized and then implemented iteratively in natural settings. This is in order to test the validity of extant theory and to generate new theories for conceptualizing learning, instruction, and design processes, including technology-based instructional design (Christensen, Gynther, & Petersen, 2012; Majgaard, Misfeldt, & Nielsen, 2011).

As the aim of the KATA Foundation was to positively interfere in science teaching and the aim of the PhD study was to investigate the practical consequences of such interference, an iterative DBR design was applicable. As such, KATA could continuously improve their design for the practices they wanted to impact while the research simultaneously gained knowledge about the practices, the methods used, and oPDI design. Therefore, research and development are two mutually qualifying constructs in that research becomes possible though development, testing, adjustments, and improvements of design.

The dissertation research aims to shed light on the practical value of oPDIs; thus, it must investigate the complexity, potential contradictions, and inconsistencies of lived practices. Here, DBR is an important methodology for understanding how and why educational interventions work in practice (Design-Based Research Collective, 1999). Notably, while DBR researchers investigate interactions of different variables, they acknowledge that within learning environments such interactions and variables are often too complex to exhaust or completely understand – an acknowledgment this dissertation seconds.

Figure 3: Predictive vs. Design Research (in Amiel & Reeves, 2008)



The TPD intervention initiated by the KATA Foundation was named "Klog på naturfag" (KpN); the closest translation to English is "Smart about Science." In close similarity to the DBR cycle in Figure 3, the KpN development took place through collaboration between stakeholders (Box 1, Figure 3). Specifically, subject matter experts from University Colleges, a group of teachers for whom KpN was intended, instructional designers, the KATA project manager, and myself as researcher participated in the design process. Practitioner input was, however, solely provided at meetings facilitated by KATA and the instructional designers. The overall purpose of KpN – to advance science teaching through increased use of inquiry-based teaching – was pre-defined by KATA, and the topic and learning objectives of KpN were primarily a result of subject matter input. Thus, the extent to which the practitioners "participated" in design is debatable.

Next, KpN was developed in order to be tested in practice. The KpN design principles (see Section 6.2) were largely a result of my empirical and theoretical work on the transfer of learning (Chapter 5).

The third box of Figure 3 addresses how data is collected systematically and reflected upon in order to refine and test possible solutions and the principles that might best address them, resulting in a "continuous cycle of design-reflection-design" (Amiel & Reeves, 2008, p. 35). Section 4.2 illustrates the manner in which this occurred in the dissertation research.

Design research is contextualized in educational settings, but commonly, the aim is to generalize principles from those settings that can implemented by others in similar

settings (Amiel & Reeves, 2008; Collins, Joseph, & Bielaczyc, 2009). Similarly, the PhD study aimed to generate design principles. Concurrently, pragmatism has no objections to abstractions and theorizing as long as the aid of the particular and concrete is leveraged and "they actually carry you somewhere" (James, 1907, p. 10). It will therefore be especially important to generate design principles that point to specific (though always normative) design suggestions. As Amiel and Reeves (2008) explained, the aim of DBR is "not just to evaluate an innovative product or intervention, but [DBR] systematically attempts to refine the innovation while also producing design principles that can guide similar research and development endeavors" (pp. 34–35). Again, the design principles that guided the design of the KpN oPDI are described and discussed in Section 6.2, and the revised design principles based on the empirical findings are presented at length in Chapter 13.

4.1. CAPTURING THE EVER-CHANGING

With fallibilist pragmatism in hand, the dissertation acknowledges and appreciates that there will be no non-time-bound universal "true" PDI design. Pragmatism does, however, leave "a need to understand how we can possess methods of inquiry that contribute to our making fallible progress" (Hookway, 2016, p. 9), which is a need the iterative approach of DBR can potentially meet. But this is also the starting point of a persistent critique of DBR. What exactly is the object of investigation, and what are we able to conclude in an investigation of continuously changing design and methods? (See Collins et al., 2009; Sannino, Sutter, & Engeström, 2011; Rikke Ørngreen, 2015). To some extent, this PhD project rests on a methodological paradox. On one hand, it is concerned with the context-dependency of learning (situated learning) and, in turn (as with practice theory), with investigating the specificities of practices. On the other hand, the project continuously interferes in hopes of changing these same practices. How can we sufficiently investigate current practices and simultaneously change them? How can we investigate design when design is continuously changed?

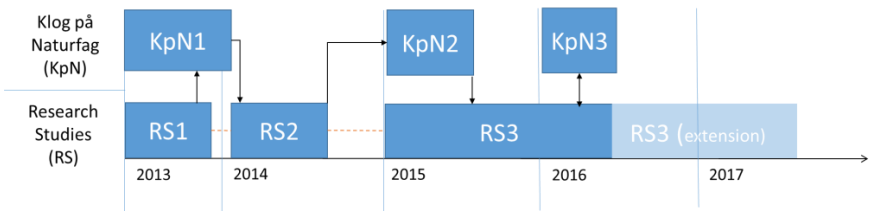
This paradox actualizes that practices are changeable, and a PDI must be viewed as a solution in a specific context and a specific point in time, once again emphasizing the fallibilist viewpoints. As such, one could argue that conducting research in controlled educational experiments is of little value to changeable practices. Still, this replacement of methodological issues does not alter the fact that when design research assumes continuous refinement, it has ramifications in the way analysis and reporting are conducted (Collins et al., 2009). Collins et al. (2009) suggested that design researchers document their designs in detail by recording all major changes in design. Design changes mark the borders of each phase. Importantly, after each phase, data should be collected and analyzed in order for the reader to evaluate the credibility of design decisions and scientific learning outcomes (Collins et al., 2009). Section 4.2 illustrates how the DBR frame of the dissertation's empirical studies were structured in this manner.

4.2. THE DBR STUDY FRAME

The PhD project and the KpN development project commenced in May 2013. Shortly thereafter, the first research study was conducted through explorative field studies at two schools (RS1). Once the first version of KpN was developed, in-depth qualitative empirical studies were carried out with seven science teachers at three Danish elementary schools (RS2).

The PhD research is an integral part of the larger DBR study. The focus area of the PhD was RS1 and RS2, while RS3 was conducted by a research group headed up by Professor Rikke Ørngreen. RS3 was originally planned to entail a statistical study and to conclude by mid-2016. However, a low number of teachers active in KpN, combined with a wish to test new research methods, led to the extension of RS3 until mid-2017.

Figure 4: Overview of oTPD Iterations and Research Studies



(Ørngreen, Jørgensen, & Noesgaard, 2016) (updated version)

Figure 4 illustrates a timewise linear view of the iterative DBR approach to the larger project. The research and development activities have continuously qualified the activities that followed. As such, the findings from RS1 were taken into account in the development of KpN1, which in turn was tested in RS2. The literature study presented in Article A (Section 2.1) was conducted alongside RS2. Based on RS2 a comprehensive evaluation report was produced and utilized for the development of KpN2, which in turn was researched in RS3, and so on. The research designs of the studies differed and were concluded at each phase; they did, however, lend inspiration, experience, and material to the ensuing research activities (depicted by the orange dotted lines in Figure 4). Consequently, the project has been a continuous iterative learning and development process.

While RS1 and RS2 shared a number of characteristics, they differed in aim, scope, methods, and consequently findings. Therefore, the specificities of the research studies will be unfolded in their respective chapters: Chapter 5 for RS1 and Chapter 7 for RS2. RS2 is the most extensive study; its findings are therefore also presented in Chapters 8 and 9. RS3 is discussed in Chapter 10, and the DBR-project iterations are concluded in Chapter 11.

CHAPTER 5. THE TRANSFER OF LEARNING

This chapter falls into two sections. First, a short review of the transfer of learning literature sets the theoretical scene for RS1 and the development of KpN1. Second, RS1 is presented in Article B, and the findings and impact on design are subsequently further discussed.

As stated, the main purpose of KpN was to improve science teaching practices at scale; congruently, the PhD project aimed to support and study the processes of advancing practices through oPD. Therefore, the transfer of learning was a primary point of interest even before the commencement of the PhD project, and the literature was reviewed simultaneously with the execution of RS1.

5.1. REVIEW OF TRANSFER OF LEARNING LITERATURE

Traditionally, *transfer of learning* is defined as the application of knowledge and skills learned in one context to another context. Thorndike and Woodworth introduced the idea in 1901, arguing that transfer of learning depends on how similar the learning task and the transfer task are, a concept now known as the theory of common elements (Thorndike & Woodworth, 1901).

This classical notion of the transfer of learning still prevails in everyday educational discourse and practice-based research and has seen numerous developments of sub-categories, attempted measurements, and models created (see Burke, 2008; Wahlgren & Aarkrog, 2012; Wahlgren, 2009). In fields where this traditional 'transportation' metaphor is accepted, there appears to be some agreement on the factors promoting or prohibiting the transfer of learning; some of these factors are presented in Article B (Section 5.2.1). However, this classical notion of the transfer of learning has been heavily criticized in academia, and many changes have been suggested. As an example, the idea of viewing the transfer of learning as a process instead of a product gained some leeway in the 1990s (e.g., Broad & Newstrøm 1992; Foxon, 1994). Foxon (1994) noted that

> evaluations of the post-course application of training focus on whether learners are using the training on the job or not. However, in treating transfer as a "product" many of the nuances of transfer are missed. The evaluation fails to assess which skills have been used, how often, and why they are not being used or used more often. (Foxon, 1994, p. 1)

To mediate this issue, Foxon (1993, 1994) conceptualized transfer as an ongoing process with emphasis on phases and the extent of transfer.

However valuable the contribution, viewing transfer as a process only serves to expand on the classical notion of the transfer of learning instead of challenging the transportation metaphor itself. Hence, this is an example of how methodological problems conflate conceptual problems, making it possible to make minor methodological adjustments without responding to the more serious concerns raised regarding the conceptual roots of transfer (Lobato, 2006).

However, as the social constructionist and situated learning perspectives (as represented by Lave and Wenger, 1991) gained popularity and became the prevailing paradigm in many academic educational circles, the transfer of learning got a spin in the centrifuge of social constructionism as well. Critiquing the classical transportation metaphor through the perspective of situated learning theory, Lobato (2006) stated that

> the "applying knowledge" metaphor of transfer suggests that knowledge is theoretically separable from the situations in which it is developed or used, rather than a function of activity, social interactions, culture, history, and context. (p. 434)

From a situated perspective, the notion of detaching from concrete experience is problematic because knowledge cannot be isolated from practice and meaningfully studied (Lave, 1988; Lave & Wenger, 1991).

While some recommend abandoning the term *transfer* once and for all, the transfer of learning in this dissertation refers to a situated perspective in which transfer of learning to practices is a process wherein the practitioner progressively re-conceptualizes knowledge, skills, and attitudes in interactions with and rooted in the specific situation; as such, knowledge is interpreted anew in a new context (see Tuomi-Grohn & Engestrom, 2003).

5.2. RS1: EXPLORING THE TERRAIN

Because of the diversity and disagreements in the transfer of learning field, RS1 adopted an open and explorative research design to be sensitive to observations that did not necessarily fit into the classical notion of the transfer of learning.

The relatively broad and explorative approach of RS1 was part of the overall DBR frame, although RS1's approach was more in line with practice theory (e.g., Halkier & Jensen, 2008) in that there was no intention to change and no design to implement. Practice theory aims to illuminate specificities of practices, whereas DBR first and foremost aspires to change practices based on researcher-defined objectives. RS1 primarily aimed to give the subsequent DBR studies a practice-based starting point.

5.2.1. ARTICLE B

Supporting Transfer of Learning:
Practice-based considerations on the applicability of transfer literature in online design.

Author: Signe Schack Noesgaard

The article was published in *Proceedings of the 4th International Designs for Learning Conference* (pp. 1–5). Stockholm, Sweden, 2014.

Supporting Transfer of Learning

Practice-based considerations on the applicability of transfer literature in online design.

Author: Signe Schack Noesgaard, Industrial PhD student at the Universe Foundation & Aalborg University, Department of Learning and Philosophy, IT and Learning Design Lab, ssn@learning.aau.dk.

Keywords: Transfer of learning, online competence development, supportive work environment, designs for learning.

INTRODUCTION

Frame and Research Questions

This paper argues that a recently completed ethnographic study of teacher practice can qualify the use of research when designing learning. The ethnographic study brings practice-based considerations to the design research in a PhD project and to a national online competence development project for school teachers. The PhD project is inspired by design-based research and the research into the transfer of learning. It aims to evaluate if, how, and why an online collaborative learning solution can improve the teaching practices of science teachers in Danish elementary schools. Based on the ethnographic study, this paper attempts to answer the following questions: What characterizes the work environment at the schools, specifically with regard to collegial support, organizational support, and manager support? How does the empirical research relate to the transfer of learning literature? Do these characteristics give rise to reconsiderations of applying the transfer of learning research when designing for competence development?

Research Design

The ethnographic study was inspired by publications on ethnography by Emerson, Fretz, and Shaw (2011) and van Maanen (2011). The study's purpose was to enrich the understanding of the teachers' practice in and outside the classroom. The author of this paper is an experienced learning professional and a researcher within the field of the transfer of learning; thus, it was assumed that she would be able to provide competent perspectives on the school cultures. At the same time, coming from learning arenas other than elementary schools, the researcher could avoid some of the cultural blind spots.

The study took place at two Danish schools. One school was large, old, and rural, with a homogeneous and affluent pool of students; the other school, located in the capital, was small, new, and had a heterogeneous pool of students. The researcher acted as an assistant teacher. As with most ethnographic studies, practices that initially seemed

strange became increasingly familiar, especially by the time the researcher began work at the second school (van Maanen, 2011). Over a four-week period, the researcher spent approximately 45 hours at each school. The study was conducted between May and November 2013, just after a national contract dispute between the teachers' union and the municipalities. This dispute was called the "teacher conflict" and resulted in the teachers' losing their contractual agreement regarding a fixed number of hours for teaching preparation. In addition, teachers' required presence at school outside of class teaching time was increased (Bomsdorf, 2013). The reader would benefit from taking this into account when reading the analysis below.

The researcher wrote detailed field notes at the end of each school day (Emerson, Fretz, & Shaw, 2011). The notes described the researcher's observations and conversations in detail. The researcher's interpretations and comments were clearly marked. Even while separating observation from interpretation, the researcher kept in mind that "culture is not itself visible, but is made visible only through its representation"(van Maanen, 2011).

The field notes were coded in a grounded approach. This revealed 34 relational, practical, and didactical categories. Eight of these were related to the teachers' work environment and surfaced in similar ways at both schools. These categories were "knowledge sharing," "professional environment," "collaboration," "time allocation," "time spent," "teacher conflict," "presence at school," and "environment – unspecified." Based on these categories, literature on transfer in relation to work environment was visited, and the eight categories were grouped into "collegial support" and "organizational support." The transfer of learning literature emphasizes the importance of "manager support" (e.g., Gunawardena, Linder-VanBerschot, LaPointe, & Rao, 2010) yet this category was absent from the ethnographic study. As will be discussed, the category is of interest precisely because of its absence.

Theoretical Frame

Jean Lobato showed that there is little agreement among researchers about the nature of transfer, the possibilities of its occurrence, and the mental or social mechanisms that may or may not underlie the concept (Lobato, 2006). Traditionally, *transfer of learning* is defined as knowledge and skills learned in one context and applied in another context (e.g., Wahlgren & Aarkrog, 2012). Among those researchers who support this definition, there appears to be some agreement on the factors promoting or prohibiting the transfer of learning across a variety of adult learning contexts at schools (Leberman, Doyle, Mcdonald, & Doyle, 2012; Wahlgren, 2009), in businesses (Gunawardena et al., 2010), and in higher education (Ginns, Kitay, & Prosser, 2010). These factors have to do with the learner (e.g., motivation and self-efficacy), the learning (e.g., clear objectives and feedback), and the learning context (e.g., collegial and manager support). With reference to the latter, a supportive work environment is perceived as a critical factor if learning outcome is to become changed practice. This is the focus of this paper.

DISCUSSION

Collegial Support: Autonomy and collaboration – a contradiction in action?

The Literature

Collegial support has been stated as the number one predictor of the transfer of learning (Gunawardena et al., 2010), and studies like that by Leberman et al. (2012) highlight the importance of collegial support at schools. In addition, the research into computer-supported collaborative learning (CSCL) underlines collaboration as key to online learning (Stahl, Koschmann, & Suthers, 2006), and several empirical studies on the effectiveness of online learning do the same (Antonis, Daradoumis, Papadakis, & Simos, 2011; Arts, Gijselaers, & Segers, 2002).

The Study

The study at the two schools painted a picture of the teachers as highly autonomous practitioners. In their actions and in their indirect and direct statements, the teachers demonstrated that they had carved out specific teaching territory in which they fully controlled the content and activities. Neither their colleagues, their principal, nor any centrally formulated goals appeared to have any direct influence on their teaching.

The teachers clearly enjoyed each other's company during breaks and meetings, but formal and informal knowledge sharing, collaboration, and even simple discussions of teaching practice rarely surfaced during the study. When asked directly, teachers at the older, larger school stated that it was difficult to see how professional collaboration or knowledge sharing – reusing each other's teaching material, for example – could save time; thus, it was not a priority. It was stated that one must be authentic as a teacher and must therefore focus on one's own interests, which are seldom the same as those of the other teachers. On the one hand, the researcher interpreted these statements as sympathetic, because the teachers wished to inspire students with their own interests; on the other hand, these statements were problematic, because the teachers' interests might dictate what the students are taught. At the newer, smaller school, some teachers appeared to believe in the potential synergies of closer professional collaboration between teachers, but at the same time, they mentioned the tendency to pay attention only to one's own teaching.

The Design

These observations spark several questions that could modify the way the transfer literature is applied in design: Is the limited professional collegial engagement and support found at the schools a challenge to transfer of learning? Is collegial support needed for the transfer of learning to take place when teachers work independently? Does a collaborative design promote transfer by forcing the teachers to reflect and collaborate on their professional practices, or would such a design lower the chances of user acceptance and thus learning application?

Organizational Support: Time to transfer

The literature
Organizational support refers to a variety of elements needed to apply the learning at work, such as the availability of resources and the opportunities to apply the learning (Gitonga, 2006; Wahlgren, 2009). One important aspect of the latter is that the learners' workload allows them time to apply their new skills during and immediately following the learning activities (Gunawardena et al., 2010; Lim, 2000).

The study
The study actualizes time allocation as a critical element of the teachers' work. Even passionate teachers seemed preoccupied with time allocation. The teachers explained to the researcher that work simply stops (or does not start) when no more hours are allocated to a project or task. This focus on hours has historical explanations, and the "teacher conflict" may have added to the perceived rigidness, because the teachers felt little appreciation of their work.

What struck the researcher as particularly peculiar was that a similar preoccupation with working hours actually spent did not exist. When asked directly, teachers either pointed to the hours allocated or stated that they could not keep track of the actual hours spent because the line between preparation work and spare time was constantly blurred.

The Design
In terms of organizational support, the study does not challenge the transfer of learning literature but instead emphasizes the utmost importance of ensuring that sufficient time is allocated for teachers to complete and apply what they have learned. With reference to the lack of attention given to the actual time spent, one might question whether designers can ensure that time allocated will actually be spent on the solution; should time, however, not be allocated in the first place, teacher engagement with the solution is likely to be limited.

Manager Support: Not a category – not a need?

The Literature
In discussions of work climate, management often receives profound focus. A manager's support of a learner's attempts to apply new learning and skills has an essential impact on the degree to which the transfer of learning takes place (Baldwin & Ford, 1988; Ginns et al., 2010; Wahlgren, 2009).

The Study
At no point in the approximately 65 pages of field notes did the teachers mention school management. Thus, management did not become a category during coding. Based on this and on the profound professional autonomy of the teachers, it was assumed that management was not desired resource for professional sparring. The

principals at these schools exercised little authority and provided little coaching on the way the teachers perform their teaching.

The Design

Once again, these observations call into question the applicability of the transfer research when designing for this target audience: Is it necessarily a challenge to transfer that little professional managerial support is found to exist at the schools? Is manager support needed for the transfer of learning to take place when teachers work this independently? Should online learning design refrain from engaging the manager, as teachers apparently find manager support unimportant or undesirable? Should the literature or the empirical study take precedence in design?

CONCLUSION

In sum, the work environment at the schools was characterized by little professional, collegial, and managerial support for the teachers' professional practice, and time allocation was perceived as a key driver to teachers' engagement in tasks. In terms of collegial and managerial support, the study calls into question when and how the research should be applied in design.

This paper presents an initial understanding of the teachers' practice and poses critical questions to the application of transfer literature in design. Hence, one may argue that a continuous investigation of and (meta-)reflection on teacher practice can help developers critically prioritize and apply research in the design of competence development processes. In sum, this paper argues that the most important factor promoting transfer is the designers' in-depth understanding of, reflection on, and involvement in the transfer context.

REFERENCES

References can be found in the dissertation's literature list.

5.3. KEY CONTRIBUTION

RS1 gave new considerations to the field of the transfer of learning as well as a rare glimpse into the everyday practices of Danish teachers at two schools. Despite the diametrically differences of the schools (large/small, new/old, city/village, homogeneous/heterogeneous student group), the findings on collegial, organizational and managerial support were surprisingly similar.
The primary finding is that extant research, transfer research specifically, needs to be filtered through the specificities of the practices, which it aims to impact. While this premise is widely accepted on social constructionist discourse, the study highlights that even transfer promoting factors generally hard to dispute, may lose their value in certain settings, ex. Manager support in teaching contexts. Consequently, the value and thus the prioritization of transfer design recommendations depends on the specificities of practices. RS1 was not born in in a social constructionistic and situated learning frame, but it illustrates how specificities to Danish school cultures were likely to impact the effectiveness of oPDI in a way that partly runs counter to generally accepted promoting factors of oPDI effectiveness in learning transfer to practices. Thus, Article B emphasizes the importance of a supported context and to an even greater extent it highlights the context dependency of what promotes the effectiveness of oPDI. Hence Article B set the scene for the situated perspectives that would prove critical later in the PhD study.

5.3.1. IMPLICATIONS FOR DESIGN

RS1 gave particular attention to contextual factors in the design process of KpN; specifically, RS1 impacted how time was allocated. The KATA project manager made a great effort to ensure that teachers were given sufficient waged time to complete the KpN learning process in RS2. Additionally, I ensured that every module of KpN had visible, specific, and conservative time estimates in order to set expectations for the teachers' use of time.

Moreover, it was important for KATA that KpN become a collaborative platform. RS1 emphasized that teacher collaboration was likely limited; KpN was therefore designed with structured and specific collaborative exercises to guide the teachers in their collaborative effort on the path to completing KpN.

RS1 also impacted the research design of RS2; RS2 had to have an open and explorative approach as well, because RS1 had shown that unexpected contextual factors could have a critical impact on oPDI effectiveness.

CHAPTER 6. KPN: DESIGN AND DEVELOPMENT

This chapter presents the high-level definitions of effectiveness, the design principles and the learning objectives leading to the design of KpN1.

6.1. STAKEHOLDER POSITIONS AND EFFECTIVENESS DEFINITIONS

Despite the shared high-level objective to advance science teaching practices, the definitions of effectiveness differed among the three stakeholder positions even at the outset of the project.

Table 1. Stakeholder Positions and Definitions of Effectiveness

Stakeholder	Main position	Primary definition of *effectiveness in advancing practices*
KATA Foundation	Initiator	KpN scalability to reach as many teachers as possible
PhD Researcher	Researcher	Researching effectiveness in advancing practices
Teachers	Practitioners	Improving own teaching competency and student learning and engagement

The KATA Foundation's primary objective is to reach as many teachers as possible with KpN. Specifically, the goal is to have 1000 teachers complete at least one course, with a total of 2000 courses completed by the end of 2017. The Foundation is also interested in KpN impacting teaching practices and has thus been concerned with the extent to which teachers fulfill the behavioral learning objectives and initiate change based on KpN. Supported by the PhD researcher, the KATA Foundation selected an e-Learning agency to do most of the workshop facilitation, instructional design, and IT development.

As the PhD researcher, I have participated in both the design and the research for KpN. I did not research my own practice (as is done with participatory action research) but acted as researcher with affiliation to the PDI initiator. With reference to Ejersbo et al.'s (2008) discussion on a (not necessarily contradictory) duality between the need for system development and theory development, KATA and its suppliers have primarily worked on the following phases: problem, design, intervention, and the final product (KpN) offered to the teachers. I have worked in parallel in the following phases; problem, data gathering, data analysis, and theory generation. It is, however, important to stress that the research design of RS2 (see Section 7.1) was deliberately designed as both a PD and a data-gathering process. To this end, I have researched and facilitated learning sessions based on KpN1 with the teachers participating in

RS2. Leveraging my experience and resources in design and learning facilitation has impacted the learning and actions of the participants (more on this in Section 8.2.2).

With regard to the practitioners, the definition of effectiveness as "improving own teaching competency and student learning and engagement" (Table 1) proves simplistic. Thus, the dissertation gives ample space to discussion of the nuances in the positionings, specifically their negotiations and strategies in defining oPDI effectiveness (Chapter 9). As Table 1 illustrates differences in definitions of effectiveness are, however, evident between the stakeholder groups as well.

Like other educational interventions, oPDIs are value-laden. This necessitates an investigation of the "why" of interventions and educational technologies, including an evaluation of the values that are promoted by their agendas (Amiel & Reeves, 2008, p. 33). KpN aimed at initiating inquiry-based teaching methods in the classrooms of K–5 science teachers. Consequently, KpN implies that inquiry-based teaching methods are superior to "traditional" teaching methods currently applied by the teachers. As inquiry-based teaching in science is reflected in the contemporary educational paradigm of active pedagogy and project-based learning, criticism of the application of inquiry-based teaching methods is unlikely to be voiced. Initiators thus have the "right" to promote (and *are* "right" in promoting) a change in teaching when the change is in concurrence with contemporary educational paradigms. As a result, current teaching practices are implicitly deemed wrong and so are any advocates thereof. Reflections on the historicity and social construction of educational paradigms can question whether current teaching is necessarily inadequate and can initiate design discussions on, for instance, integrative approaches introducing new teaching aspects while respecting effective elements of current "traditional" teaching.

6.2. THE DESIGN OF KPN

KpN was developed in an iterative process whereby subject matter experts and untrained K–5 science teachers continuously provided their knowledge and experiences (as illustrated with Figure 3). This process took place in the fall of 2013. The design of KpN was informed by extant literature on the transfer of learning; specifically, a newly published book, *Transfer* (Walgreen & Aarkrog, 2012) provided guidelines for the design.

The review of transfer of learning literature (Section 5.1) was conducted alongside the KpN development, and its situated perspectives were thus not a primary consideration in the development of KpN. In terms of the literature study (Article A: Section 2.1) there are clear overlaps between the design principles of KpN and the factors, which the field identified as promoting effectiveness in the literature study (Table 5 and Figure 2 in Article A, Section 2.1).

Van den Akker (1999) described how heuristic design principles can support designers in applying the most appropriate knowledge in their design and

development tasks. According to van den Akker, design principles follow formats in the following way:

> If you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R. (van den Akker, 1999, p. 9)

Inspired by this format, the common denominator of the stakeholders' definitions was to design KpN as an online platform for the purpose of advancing K–5 science teaching practices. To do so, agreement was reached to design KpN based on transfer of learning literature, and specifically on the characteristics, procedures, and arguments listed in Table.

Table 2. KpN High-Level Design Principles

CHARACTERISTIC	PROCEDURE	ARGUMENT
LESS-IS-MORE	Content is split up in smaller modules. One module = one learning objective. Tasks and exercises are procedure-like.	To avoid cognitive load. To make content actionable.
COLLABORATION	Opportunities to discuss the content and application with peers.	Commitment to group agreements; increase reflection and be inspired by each other.
PRACTICE	Practitioners practice during and after instruction.	To initiate new behaviors while supported and motivated.
RELEVANCE	Content reflecting work situations. Aimed at specific target group.	To increase motivation and self-efficacy to apply in own practice.
REFLECTION	Opportunities for systematic reflection.	To understand limitation and opportunities in current and changed practice.
TIME	Time is allocated to complete and apply the learning. Clearly state time needed.	If time is not allocated and expectation managed, efforts to initiate change may seize.

Despite general agreement on the appropriateness of the design principles, the procedures needed did lead to interesting design discussions between the KATA Foundation, the e-Learning agency, and myself as researcher. My concerns with the transfer of learning, for instance, came into effect particularly when discussing the learning objectives and design with instructional designers for the e-Learning agency. As an example, focusing on oPDI transfer of learning to practices, I insisted that the

learning objectives of KpN include higher taxonomical levels than the e-Learning agency suggested, as we wanted the teachers not only to *understand* the content, but to *apply* the content. This resulted in KpN including in-class practice. The agency also suggested developing a package of modules with tools that would teach teachers how to collaborate. Again, the aim with collaboration was not only to learn *how* to collaborate but to actually collaborate during the KpN PD process. Thus, KpN exercises were design as collaborative exercises to promote collaboration *while* engaging with KpN.

6.3. SUBJECT MATTER

At RS2 commencement, KpN consisted of four courses (Table 3). One course was a general video introduction to inquiry-based teaching followed by a reflection exercise (this course was called 'Inquiry-based Method'). The three remaining courses covered different aspects of inquiry-based teaching, focusing on productive questions, language and terms, and practical work respectively. Each of these three courses consisted of 7-10 modules. The main behavioral learning objectives of the courses are listed in Table 3.

Table 3. Main Objectives of KpN1 Courses

COURSE	MAIN OBJECTIVES
INQUIRY-BASED METHOD	Applies the inquiry-based method presented to structure the teaching.
ENGAGING QUESTIONS	Applies productive questions to create curiosity and engagement.
LANGUAGE AND TERMS IN SCIENCE	Works systematically to teach scientific language and terms.
PRACTICAL WORK	Plans practical activities with different levels of openness.

Based on the design principles, KpN was designed to facilitate the PD process online and included modelized content of a) theoretical knowledge and practical tools delivered through of videos, guided animations; and quizzes; b) guided preparation for in-class practical training; c) the actual in-class practical training; and c) reflection exercises on participants' own teaching before and after each practical training. This is illustrated in Figure 5.

Figure 5: Online Platform KpN: Structure and Content

KpN1 content and structure were tested in RS2, which has been the most extensive study in the PhD study. The data collected was multi-faceted and enabled several important findings and related (meta-)discussions. Therefore, the following three chapters are dedicated to RS2. Chapter 7 describes the RS2 research design in detail; Chapters 8 and 9 present and discuss key findings of RS2. Chapter 8 focuses on descriptive statistics informed by categories from a grounded analysis (see Section 7.4.4), which leads to a discussion of how we can measure effectiveness. Chapter 9

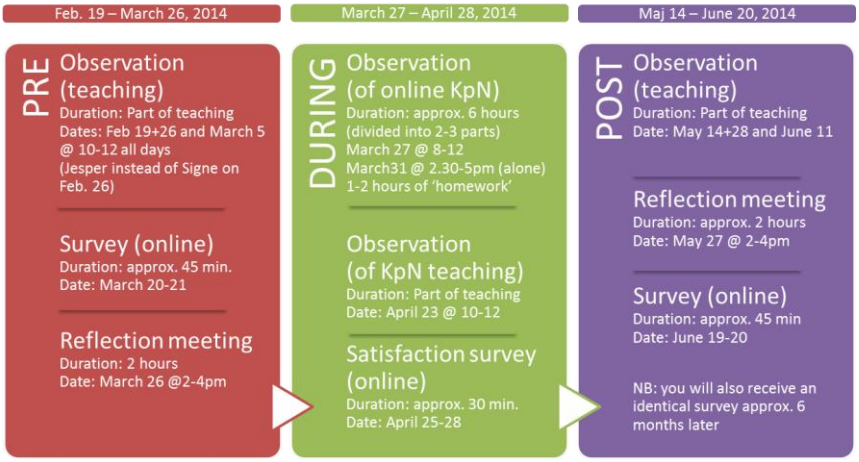
focuses on key findings of the grounded analysis to present and discuss some of the complexities in changing practices.

CHAPTER 7. RS2: ONLINE PROFESSIONAL DEVELOPMENT IN PRACTICE

RS2 included seven teachers at three Danish public schools at three different locations. The three schools were selected in cooperation with the senior project manager at the KATA Foundation, Jesper Ingerslev, who headed up the KpN project. The schools represented different parts of Denmark, both in terms of location, size of town/city and school, and affluence of the area. While it would be interesting to identify characteristics impacting the effectiveness of oPD across diverse schools, the goal of the school selection was not to attempt to simulate a representative sample in order to generalize in quantitative terms but simply to allow for differences and variations. It should be noted that the principals at the three schools were part of Jespers Ingerslev's professional network, and their onboarding depended on this connection. As such, the school selection had elements of a convenience sampling, which could raise credibility concerns. However, for this qualitative study, conducted while the most profound school reform in recent history was taking place, these personal connections were critical to the study's existence, as few schools were willing to prioritize new projects during this time. Thirteen teachers were asked by the three principals at the schools if they wanted to participate. Participation was voluntary, although it is possible that some of the teachers felt indirectly pressured to react positively to their principal's request.

Once the seven teachers were confirmed, a number of introductory and alignment meetings took place at the three schools from October 2013 to January 2014. As RS1 highlighted teachers' heavy focus on time spent (hours) and activities completed (Article B, Section 5.2.1), great effort was placed on the coordination, scheduling, and confirmation of activities before the KpN program began. Each of the seven teachers received an individual time and activity plan (Figure 6) in addition to calendar invitations for every single activity.

Figure 6: Sample Teacher Time and Activity Plan



KATA desired to have all four KpN1 courses tested within the scope of RS2. This required completion by summer break in order to improve course designs before the next school year. As time for reflection, collaboration, and in-class practice was considered key to the transfer of learning (see Section 6.2), we decided that all teachers would participate in the 'Inquiry-based Method' course but divided the three other courses among the schools (instead of cutting the individual courses short in order for the teachers to complete all of them). While this to some extent impedes direct comparison of the teachers' trajectories across courses, the relevant learning processes that materialized in the course structures were almost identical. In addition, non-content-related similarities in reactions and behavior may have become more visible this way, which is of value to the study.

7.1. DATA GATHERING PROCESS

The data gathering was designed to serve a triple interrelated purpose: 1) to evaluate the effectiveness of KpN1 for the KATA Foundation, 2) to explore the complexity of changing practices through PDIs, and 3) to generate new design principles – all while giving participants the best possible learning experience. Therefore, RS2 was deliberately designed as a PD program as well as a research study in line with the DBR-inspired methodology. Hence, the research design was both influenced by a need to evaluate the progress of the teachers on pre-defined learning objectives and a need to allow for potentially unforeseen influencers on the advancements of teaching practices. This open and explorative approach reflected a desire to avoid solely evaluating on pre-defined learning objectives. Performance on objectives may not necessarily advance practices, and practitioners' definitions of effectiveness may

prove important for understanding what does advance practices; hence, the research design should make space for such considerations.

7.2. MIXED METHODS

The empirical dissertation research rests on the assumption that an in-depth investigation of the narratives and actions of a small number of oPD participants can provide valuable knowledge that broad, large-scale quantitative studies cannot. Quantitative data can, however, be an important starting point from which to expand with qualitative explorations and contextualities (Flyvbjerg, 2006). Traditional quantitative data gathering methods and analytic approaches (e.g., rating scale surveys and descriptive statistics) have, thus, been included in the primarily qualitative RS2 study to assist the qualitative research with visual data analysis. The way the quantitative approaches are viewed in this dissertation is illustrated in Mackenzie and Knipe's (2006) description of the constructivist approach in their discussion of the dilemmas associated with paradigms, methods, and methodology:

> The constructivist researcher is most likely to rely on qualitative data collection methods and analysis or a combination of both qualitative and quantitative methods (mixed methods). Quantitative data may be utilized in a way, which supports or expands upon qualitative data and effectively deepens the description. (Mackenzie & Knipe, 2006, p. 196)

The quantitative elements thus support the analysis by providing illustration opportunities and addressing concerns about measuring oPD effectiveness (Chapter 8) as starting point from which complexity can be added (Chapter 9). In addition, the different kinds of data enable data triangulation (e.g., as described by Denzin, 1978). Data comparison allows for the investigation of variations and nuances, thereby enriching the dissertation's discussion of measurements and oPD effectiveness.

7.3. DATA DETAILS

Data was gathered from February 2014 to May 2015. The primary data consisted of extensive in-class video recordings and observations over the first five months of the data gathering period. Ethnographic and survey data was gathered in similar ways and weight before (PRE-phase), during (DURING-phase), and after (POST-phase) teachers interacted with KpN (Noesgaard & Ørngreen, 2015). The PRE-phase served as both a baselining of the research and a way to observe behavior and gather narratives about the teachers' current practices. The DURING-phase centered on the teachers' interactions with KpN1 and each other, whereas the POST-phase was concerned with potential changes to teaching behavior (transfer of learning). Table 4 illustrates the research activities in the three phases. The activities are described further below Table 4.

Table 4: Research Design: Gathering Data

	PRE (Feb. 2014–April 2014)	**DURING (April 2014–May 2014)**	**POST (May 2014–June 2014)**	**Follow-up (Dec. 2014–April 2015)**
Teacher Activity	Preparation and teaching as normal	Alternation between online modules, preparation, and teaching as per guidelines in modules	Preparation and teaching without TPD requirements and support	
Observation	Two-way video recording in class; observation protocol on TPD objectives, class structure, and exploratory notes	Camtasia recording and in-person observation of online interactions; two-way video recording in class; observation protocol on TPD objectives, class structure, and exploratory notes	Two-way video recording in class. Observation protocol on TPD objectives, class structure, and exploratory notes.	
Reflection meetings	Reflection session on current practice		Reflection session on changes to practice	
Surveys	Pre-survey	Satisfaction survey	Post-survey	Follow-up survey

(Noesgaard, 2016c)

All data and content were collected and kept in Danish and were not translated before the analyses in Word, NVivo and Excel were completed. The material was translated into English at the interpretation and communication of results phase.

7.3.1. IN-CLASS OBSERVATION

The primary empirical data from the study consisted of extensive in-class video recordings and observations. Teaching methods were recorded using a mobile ethnographic approach, which means that data was collected using mobile technologies "controlled" by the participants: "While classical ethnographers travelled to distant locations to participate in the target society's everyday life to gather data, modern ethnographers use modern technology to get under the skin of the target group" (Muskat, Muskat, Zehrer, & Johns, 2013, p. 59). In RS2, however, I was both physically present at the schools and used mobile cameras: teachers had small

camcorders attached to their necks, which enabled me to view the classrooms from the teachers' perspective. The teachers were also recorded on a different camera to enable me to see the teachers and to enable teachers to later observe their own teaching.

The observation protocols included evaluation of the behavioral objectives of all four courses, despite the fact that each teacher participated in only two of them. As such, the two courses in which a given teacher did not partake functioned as control parameters. The protocols also included the specific duration of each class activity (lecture, group work, etc.). In addition, unstructured rich notes on in-class observations were taken. These included, but were not limited to, notes on teacher–student interactions, student engagement, and teachers' apparent frustration and excitement.

The data consisted of approximately 120 hours of in-class video recordings and 100 pages of observation notes.

In the course of the RS2 observation, many smaller changes and challenges occurred, such as camera problems and changes to teachers' appointments. The research did allow for changes to research design based on unexpected learning gains; for example, I learned that observing a complete topical (non-KpN) course for each teacher PRE- and POST-intervention was more important than an equal amount of RS2 observation time. This was because the courses all followed a similar structure: introduction and lectures in the first classes, followed by practical work that could extend over 1-3 classes, with conclusions in the last class. As this course process impacted teacher–student interactions to a large extent, comparing across teachers had to be based on a full topical teaching course instead of merely the observation time. It should be noted that the teachers also taught different topics at different times in the observation period. The subject matter of the courses will likely have had an impact on the engagement of the students and the teachers.

7.3.2. OBSERVATION OF ONLINE INTERACTIONS

The teachers' interactions with KpN, including their preparation for classes, were recorded by Camtasia, a software program that recorded teachers' screen and mouse movements as well as their faces and voices in a picture-in-picture format. Here, a think-aloud approach was applied. Simply put, the teachers were asked to speak their thoughts aloud while interacting with the KpN modules individually. It was a challenge to have teachers do this consistently; they appeared to be uncomfortable with this approach, at least initially, and they found it difficult to speak when tasks required their full attention, a well-known issue when using this method (Preece, Rogers, & Sharp, 2002). This became easier as teachers worked together in groups of two or three; thinking aloud became a natural way of conversing. The think-aloud method is assumed to give access to the cognitive processes of the participants

(Nielsen, Clemmensen & Yssing, 2002), but in the PhD research, participants' statements were instead viewed as retrospective narratives in a social constructionist manner. As with discourse research, there is not a presumption that subjective meanings can be illuminated (Gergen, 2014, pp. 56–57); instead, the dissertation will treat teacher narratives as social strategies, which will be discussed in Section 9.1.

The Camtasia video recordings were transcribed (selectively rather than verbatim); the transcriptions included gestures and notes from live observations. Memos were written down separately from early hypotheses and interpretations. The data consisted of approximately 25 hours of video recordings and 40 pages of observation notes of teachers' interactions with the online course.

7.3.3. REFLECTION MEETINGS

As the PhD researcher, I held reflection sessions with the teachers in which they watched and commented on video recordings of their teaching in groups of two or three. These sessions were inspired by mind tape methodologies consisting of retrospective interviews, also referred to as the stimulated retrospective verbalization method (Kumar, Jyoti; Yammiyavar, Pradeep; Nielsen, 2007). This meant that teachers watched videos of their own teaching and were asked to verbalize what they remembered to have been thinking, feeling, and considering throughout the teaching in the video clips. As with the think-aloud method, mind tapes have been viewed as a way of capturing cognitive processes and experiences (Kumar, Yammiyavar & Nielsen, 2007). Again, the PhD work is less concerned with these processes but finds value in the narratives the teachers create to describe their experiences.

Teachers were asked if they wished to select the video clips for the reflection sessions, but they preferred to have me make the selections. Teachers were able to view the clips in advance so they could prepare, and they were allowed to decide if portions should be excluded. Selecting the video clips allowed me to focus on specific elements of the teaching in which teacher's feedback was needed to confirm or challenge my interpretations.

The reflection sessions were conducted before the teachers engaged with KpN and after they had completed all assignments. The sessions were conducted as part of the PRE-phase baselining in order to get a deeper understanding of current practices, but they were also perceived by the teachers as a valuable part of the learning process, enabling them to see elements of their teaching of which they were previously unaware. In addition, they appeared to find inspiration from each other's teaching, resulting in reuse of each other's themes and teaching material. The reflection sessions were recorded, and unstructured notes were taken.

The extent to which KpN was a blended learning platform is debatable. Applying the most-used definition of *blended learning* as a combination of online and face-to-face

instruction (Hofmann, 2006), KpN was not a blended intervention, despite the fact that the teachers worked collaboratively. The PD process constructed around KpN1 in RS2 was, however, a blended intervention, largely because of my facilitation of these reflection sessions.

7.3.4. SURVEYS

Teachers responded to four surveys over the course of RS2: a PRE-survey shortly before initiating the process, a satisfaction survey immediately following the conclusion of KpN, and a POST-survey (identical to the PRE-survey) approximately one month after completing the intervention. The POST-survey was repeated approximately 6–9 months after completion (it was distributed 6 months after completion, but it took 3 months before all had responded). All surveys were distributed, answered, and collected online via SurveyExact.

The satisfaction survey questions were created based on the factors deemed important in the transfer of learning literature, e.g., relevance, application, and the transfer contexts at the schools (Wahlgren & Aarkrog, 2012). This was also the case for the 20 questions of the identical pre-, post- and repeated post-surveys, which in addition aimed to shed light on the motivation, knowledge, and self-assessed application at different times of surveying. The knowledge questions consisted of free text answers instead of multiple choice answers so teachers would freely describe what they understood. This allowed me to better evaluate the responses in relation to the learning objectives and determine whether respondents had understood the questions correctly.

To understand the teacher's self-assessed performance on learning objectives before and after the intervention, the surveys used a retrospective behavioral question for each behavioral learning objective of KpN. Using retrospective behavioral questions meant that the questions referred to specific in-class teaching that had taken place; this was done to avoid hypothetical questions and answers. The classes the questions asked about were the same classes in which in-class observation took place, enabling a comparison of different kinds of data. In terms of the phrasing of the questions, great emphasis was placed on phrasing the questions in a way that enabled teachers to answer without using the terminology introduced in the KpN. This allowed for the possibility that teachers were already teaching according to KpN objectives without necessarily applying the KpN terminology.

The surveys themselves went through an iterative process. First, all surveys were piloted before being sent to the RS2 teachers. In the pilot, surveys were sent to six teachers at the two RS1 schools. The RS1 teachers knew that they were testing the surveys, but they were asked to answer with regard to their own teaching to make it feel as real as possible. Several survey questions were amended in response to teachers' feedback.

Second, the RS2 surveys were amended once again after the data analysis gave new insights on opportunities for improving them; for example, adding more questions to understand the importance of in-person facilitation. The new surveys were intended to become the primary data gathering method in a quantitative study in the next iteration of KpN. The KATA Foundation worked on getting 50–100 teachers to complete KpN2 (see Figure 4) by mid-2015, but their attempts to reach this level of participation on KpN2 in 2014–2015 largely failed (this is explored further in Chapter 11). The surveys were instead forwarded and used by the research team conducting RS3.

Looking back on the finding from the literature study in Article A, the most common research design in the field of e-Learning was quantitative PRE-POST-surveys on learning outcome. Qualitative studies are relatively rare and a research design entailing PRE-POST data in such studies is even rarer. It is, however, accepted that this set-up for RS2 does more than enable comparison of teacher performance on learning objectives: it can investigate the trajectories of the change and perseverance of narratives and actions and, in doing so, unfold some of the strategies, variation, and complexities surrounding these trajectories. In addition, the literature study showed how most qualitative studies use only one definition for effectiveness. The RS2 research design, on the other hand, focuses on the advancement of practices by means of multiple parameters, such as learning outcome, satisfaction, self-efficacy, and change in behaviors. In sum, the exploratory aim and design of RS2 is, in combination with a PRE-POST research design, a rather unique research design that can potentially yield new perspectives in the field of oPD effectiveness.

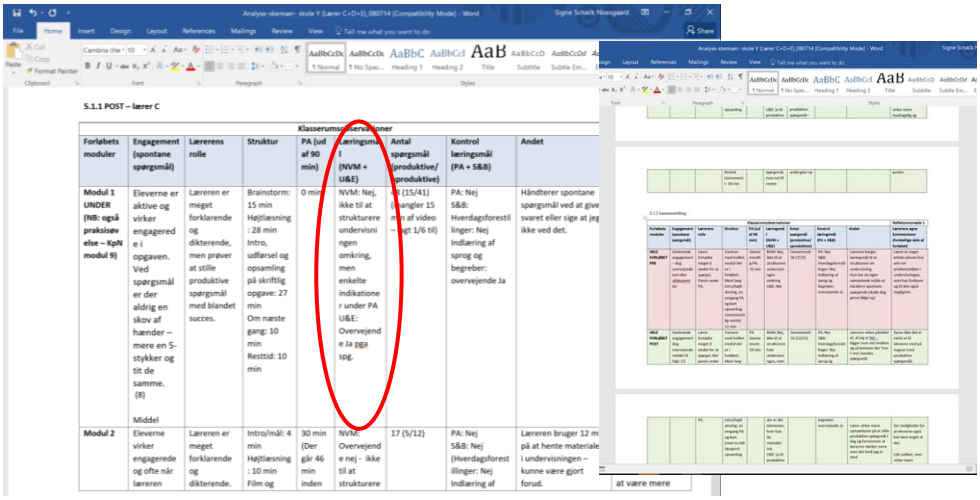
7.4. DATA ANALYSIS PROCESS

RS2's analytic approach consisted of a variety of data comparisons: between teachers, between schools, between before and after, between learning objectives, between self-assessments (surveys) and observations, etc.

7.4.1. STRUCTURING FINDING – WORD ANALYSIS

The information from the observation protocols were thematized in word tables. Corresponded with the protocols, the themes were student engagement, teacher's role, structure of the class, and learning objectives. Notes not fitting these categories were included in an "other" column. Lastly, notes from the reflection sessions after the PRE- and POST-phases were added to the tables to add perspective to the observations with the teachers' statements in these meetings. For each teacher, every class received a row in which the data was briefly summarized (example in first screenshot in Figure 7). The data was also summarized for the PRE- and POST-phases for each teacher and the changes were summarized (example in second smaller screenshot in Figure 7).

Figure 7. Initial Word Analysis of Qualitative Data



5.1.1 POST – lærer C

Klasserumsobservationer								
Forløbets moduler	Engagement (spontane spørgsmål)	Lærerens rolle	Struktur	PA (ud af 90 min)	Læringsmål (NVM + U&E)	Antal spørgsmål (produktive/ uproduktive)	Kontrol læringsmål (PA + S&B)	Andet
Modul 1 UNDER (NB: også praksisøvelse – KpN modul 9)	Eleverne er aktive og virker engagerede i opgaven. Ved spørgsmål er der aldrig en skov af hænder – mere en 5-stykker og tit de samme. (8) Middel	Læreren er meget forklarende og dikterende, men prøver at stille produktive spørgsmål med blandet succes.	Brainstorm: 15 min Højtlæsning : 28 min Intro, udfærsel og opsamling på skriftlig opgave: 27 min Om næste gang: 10 min Resttid: 10 min	0 min	NVM: Nej, ikke til at strukturere undervisningen omkring, men enkelte indikationer under PA U&E: Overvejende Ja pga spg.	9 (15/41) (mangler 15 min af video – regt 1/6 til)	PA: Nej S&B: Hverdagsforestillinger: Nej Indlæring af sprog og begreber: overvejende Ja	Håndterer spontane spørgsmål ved at give svaret eller sige at jeg ikke ved det.
Modul 2	Eleverne virker engagerede og ofte når læreren	Læreren er meget forklarende og dikterende.	Intro/mål: 4 min Højtlæsning : 10 min Film og	30 min (Der går 46 min inden	NVM: Overvejende nej - ikke til at strukturere	17 (5/12)	PA: Nej S&B: Nej (Hverdagsforestillinger: Nej Indlæring af	Læreren bruger 12 m på at hente materiale i undervisningen – kunne være gjort forud.

These tables present a substantial amount of information that could be investigated in this dissertation. To stay focused on the first research question, however, the analysis and results presented will focus on evaluations of teachers' performance of the learning objectives for each class observation in the PRE-, DURING-, and POST-phases (example in red oval in Figure 7).

7.4.2. DESCRIPTIVE STATISTICS – EXCEL ANALYSIS

In the word analysis, the rich notes from the observation protocols had been synthesized into short descriptions on the extent to which the teachers performed on each of the objectives (example in red oval in Figure 7). In Excel, these descriptions were translated into a 0-6 scale ranging from *teaching behaviors fully aligned with the behavioral learning objective* (rating: 6) to *no indications of behavior aligned with learning objective* (rating: 0). Protocol rating are generally done in situ, but here the rich in-class descriptions took precedence and allowed for focused comparative evaluations supported by video recording to take place after the classes. The ratings are presented with key results of the descriptive analysis in Chapter 8.

As Chapter 8 will show, when using descriptive statistics, RS2's analysis does not conclude with averages or attempt to control or avoid variation; on the contrary, it focuses on finding and understanding variation and potential "outliers." Descriptive statistics were used for this purpose in order to visualize and support the qualitative data. More details on this part of the analysis and its findings are presented in Chapter 8.

7.4.3. GROUNDED THEORY – NVIVO ANALYSIS

Understanding why practical consequences of oPDIs surface – and thus understanding the complexity and dynamics at play in the PD processes – requires openness and sensitivity to unexpected perspectives in the analysis. For this reason, a grounded theory approach was needed in analyzing RS2 qualitative data. DBR studies are frequently criticized for not focusing enough on analysis (Ørngreen, 2015). Here, grounded analysis can lend a helping hand in providing a structured analytic approach able to handle the messiness of lived practices.

Understanding the value of being informed by data as well as literature, I am epistemologically challenged by classical versions of grounded theory (e.g., Glaser, 1978, 2014; Strauss & Corbin, 1994), which aim for theoretical tabula rasa. Hence, this study is instead inspired by informed grounded theory as represented by Thornberg (2012), primarily because informed grounded theory

> sees the advantage of using pre-existing theories and research findings in the substantive field in a sensitive, creative and flexible way instead of seeing them as obstacles and threats. (Thornberg, 2012, p. 249)

In addition, the social constructionist frame of the PhD cannot co-exist with a belief in objectively discovering theory, a belief to which grounded theory aspires; thus, constructivist grounded theory represented by Charmaz (2012) is a better match, since neither the data nor the theories of this research are viewed as discovered but instead are constructed as a result of my interactions with the prior and continuously constructed knowledge of the PD field and with the empirical data.

As such, grounded theory in this dissertation refers to a constructed research and theory building process which has been thoroughly grounded in data by using grounded theory methods while being informed by existing research and theoretical frameworks.

Coding the Data

All written data was coded line-by-line in NVivo 10, a software program for coding and analyzing primarily qualitative data. The data included the observation protocols, the Camtasia transcriptions, notes from reflection meetings, and free text answers from the surveys. NVivo enables the researcher to look at the different data sources together as well as separately. At the beginning of the grounded analysis, the videos were coded directly in NVivo. This did not offer notable new perspectives; in contrast, the rich notes captured live in-class in the observation protocols appeared to lead to perspectives similar to those found through the video analysis. While the video likely captured more information regarding different modalities and the multitude of interactions, the notes' focus on aspects relevant to transfer of learning and change were a good starting point. Therefore, the strategy of analysis was flipped to use the written material as the outset of coding. Incidents of special interest in-class had been

noted in the protocols so they could easily be revisited for coding and could be used in reflection meetings. During the coding of the observation protocols, videos were revisited whenever it proved necessary or could potentially add value to the analysis.

The first data to undergo the grounded analysis were the PRE-phase observation protocols, followed by the transcriptions from the Camtasia recordings of the teachers' interaction with the online platform. Table 5 outlines the coding and analysis process in more detail.

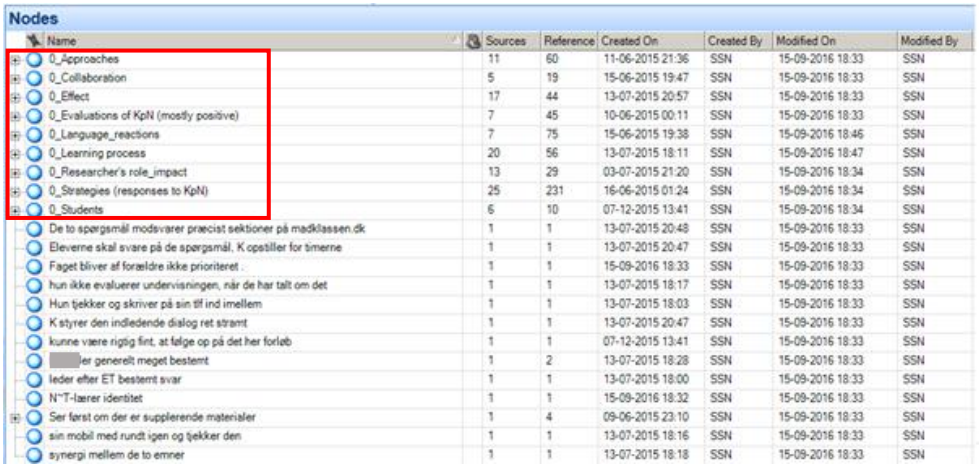
Table 5. The Grounded Coding Process

Process Step	**Details**
Line-by-line coding of PRE- phase protocols and DURING-phase Camtasia transcriptions	I used in-vivo coding, which means that I used the teachers' words, not mine. The nodes (same as codes) could be a few words to a full sentence. Teachers' identification cues were left out of nodes, and no categories were created before there were more than 100 nodes in which all of the teachers were represented.
Revisit video recordings when needed (continuously)	When the transcribed material could not transmit the situation as needed, when something was of specific interest, or when I was in doubt about how to categorize, the video recordings were watched and notes added to the protocols and coded.
Memos added (continuously)	I wrote memos of my ongoing interpretations and "tales from the field" in memos, which were kept separate from data at all times (Glaser 1978). This was done to avoid unnecessary blind spots.
Initial grouping of nodes into categories	110 nodes were created before the first categorization attempt. Any nodes not fitting smoothly into categories were left as single nodes outside the categories, as they could become relevant later or may be of interest precisely because they do not fit in. I kept the teachers' use of words when possible, but some generalization was needed to categorize. Nodes could be coded into several relevant categories.
Looking for patterns	At this point, I noticed that there was something to the language used and also that it would be interesting to investigate the differences in teachers' narratives. There also seemed to be several connected categories, but more data is needed.
Notes from reflection meetings added	Line-by-line coding as per above.

	New codes were never coded directly into pre-existing categories, and categories were never visible during coding. The reason was that I hoped to do as little interpretation of new nodes into the existing categories as possible.
Grouping into categories	As per above. However, this time I also created meta-categories such as "process," "language," etc., to structure the more than 100 categories. Found a focus on "lack of time" and variation in "approaches to the platform," "approaches to the students," and expressions of "frustration." These categories could be related to teachers' linguistic and behavioral responses to KpN.
Added observation protocols from the in-class practical training	Line-by-line coding as per above.
Grouping into categories	As per above. All previous nodes in the existing categories were revisited before new nodes were added. Sometimes the categories were split into two because there appeared to be important differences between them as more material was added.
Added observation protocols from the in-class teaching after course completion	Line-by-line coding as per above.
"Saturation"	At this point, new protocols seem only to confirm the categories identified. There could, however, be value in further confirmation and adding different kinds of data. Due to theoretical concerns with the idea of saturation – categories are created, not discovered – I decided to add more data.
Add surveys	Free text feedback from the teachers was coded as per above. This did not bring new categories, but it did bring nuances to the existing categories. Due to the initial in-vivo coding, the category names are still long and somewhat confusing in NVivo.
Meta-categories	This stage was a combination of intentional chaos (66 categories in addition to 21 nodes unaccounted for) and careful structuring and synthesis. Categories were further categorized into 9 core categories.

Figure 8 shows the nine core categories in NVivo 10 (red box). Below the core categories are single or small groups of nodes; these nodes do not fit naturally into the categories but were kept in the overview because they could still prove relevant despite, or because of, not fitting in.

Figure 8: NVivo 10: The 9 Meta-Categories

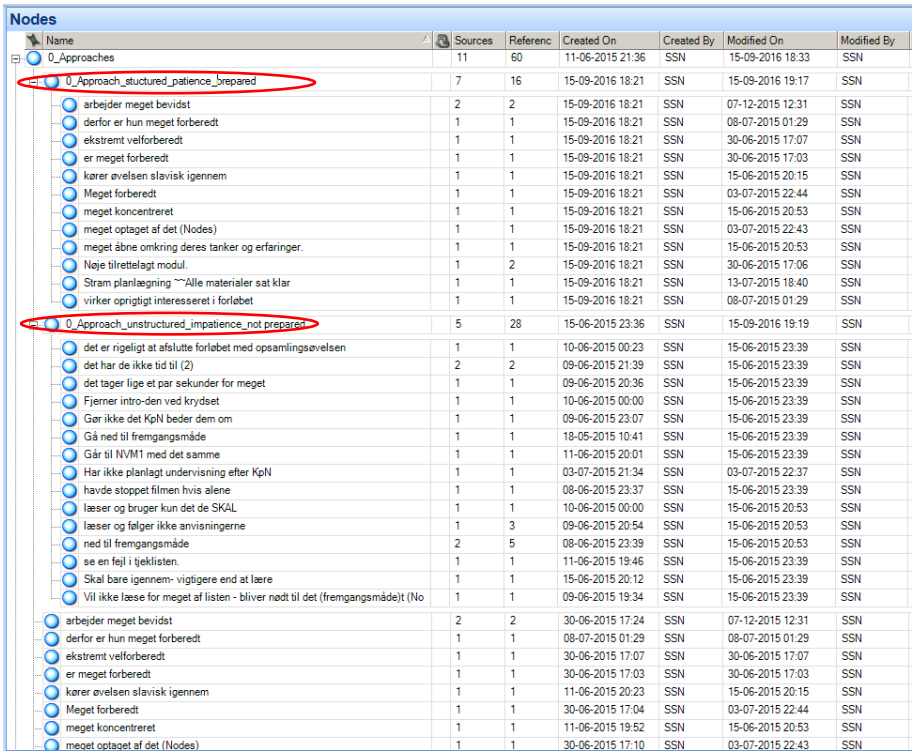


Nodes

Name	Sources	Reference	Created On	Created By	Modified On	Modified By
0_Approaches	11	60	11-06-2015 21:36	SSN	15-09-2016 18:33	SSN
0_Collaboration	5	19	15-06-2015 19:47	SSN	15-09-2016 18:33	SSN
0_Effect	17	44	13-07-2015 20:57	SSN	15-09-2016 18:33	SSN
0_Evaluations of KpN (mostly positive)	7	45	10-06-2015 00:11	SSN	15-09-2016 18:33	SSN
0_Language_reactions	7	75	15-06-2015 19:38	SSN	15-09-2016 18:46	SSN
0_Learning process	20	56	13-07-2015 18:11	SSN	15-09-2016 18:47	SSN
0_Researcher's role_impact	13	29	03-07-2015 21:20	SSN	15-09-2016 18:34	SSN
0_Strategies (responses to KpN)	25	231	16-06-2015 01:24	SSN	15-09-2016 18:34	SSN
0_Students	6	10	07-12-2015 13:41	SSN	15-09-2016 18:34	SSN
De to spørgsmål modsvarer præcist sektioner på madklassen.dk	1	1	13-07-2015 20:48	SSN	15-09-2016 18:33	SSN
Eleverne skal svare på de spørgsmål. K opstiller for timerne	1	1	13-07-2015 20:47	SSN	15-09-2016 18:33	SSN
Faget bliver af forældre ikke prioriteret .	1	1	15-09-2016 18:33	SSN	15-09-2016 18:33	SSN
hun ikke evaluerer undervisningen, når de har talt om det	1	1	13-07-2015 18:17	SSN	15-09-2016 18:33	SSN
Hun tjekker og skriver på sin tlf ind imellem	1	1	13-07-2015 18:03	SSN	15-09-2016 18:33	SSN
K styrer den indledende dialog ret stramt	1	1	13-07-2015 20:47	SSN	15-09-2016 18:33	SSN
kunne være rigtig fint, at følge op på det her forløb	1	1	07-12-2015 13:41	SSN	15-09-2016 18:33	SSN
[redacted]ler generelt meget bestemt	1	2	13-07-2015 18:28	SSN	15-09-2016 18:33	SSN
leder efter ET bestemt svar	1	1	13-07-2015 18:00	SSN	15-09-2016 18:33	SSN
N"T-lærer identitet	1	1	15-09-2016 18:32	SSN	15-09-2016 18:33	SSN
Ser først om der er supplerende materialer	1	4	09-06-2015 23:10	SSN	15-09-2016 18:33	SSN
sin mobil med rundt igen og tjekker den	1	1	13-07-2015 18:16	SSN	15-09-2016 18:33	SSN
synergi mellem de to emner	1	1	13-07-2015 18:18	SSN	15-09-2016 18:33	SSN

Expanding each of the core categories reveals the categories created and the notes from which they are derived. In Figure 9, the core category is expanded and reveals that it was found of interest that there is a clear divide between the ways in which the teachers approached and engaged with KpN (red ovals in Figure 9). This category is further explored in Section 9.1.

Figure 9. Example of Expanded Core Category



Nodes

Name	Sources	Referenc	Created On	Created By	Modified On	Modified By
0_Approaches	11	60	11-06-2015 21:36	SSN	15-09-2016 18:33	SSN
0_Approach_stuctured_patience_\prepared	7	16	15-09-2016 18:21	SSN	15-09-2016 19:17	SSN
arbejder meget bevidst	2	2	15-09-2016 18:21	SSN	07-12-2015 12:31	SSN
derfor er hun meget forberedt	1	1	15-09-2016 18:21	SSN	08-07-2015 01:29	SSN
ekstremt velforberedt	1	1	15-09-2016 18:21	SSN	30-06-2015 17:07	SSN
er meget forberedt	1	1	15-09-2016 18:21	SSN	30-06-2015 17:03	SSN
kører øvelsen slavisk igennem	1	1	15-09-2016 18:21	SSN	15-06-2015 20:15	SSN
Meget forberedt	1	1	15-09-2016 18:21	SSN	03-07-2015 22:44	SSN
meget koncentreret	1	1	15-09-2016 18:21	SSN	15-06-2015 20:53	SSN
meget optaget af det (Nodes)	1	1	15-09-2016 18:21	SSN	03-07-2015 22:43	SSN
meget åbne omkring deres tanker og erfaringer.	1	1	15-09-2016 18:21	SSN	15-06-2015 20:53	SSN
Nøje tilrettelagt modul.	1	2	15-09-2016 18:21	SSN	30-06-2015 17:06	SSN
Stram planlægning ~~Alle materialer sat klar	1	1	15-09-2016 18:21	SSN	13-07-2015 18:40	SSN
virker oprigtigt interesseret i forløbet	1	1	15-09-2016 18:21	SSN	08-07-2015 01:29	SSN
0_Approach_unstructured_impatience_not prepared	5	28	15-06-2015 23:36	SSN	15-09-2016 19:19	SSN
det er rigeligt at afslutte forløbet med opsamlingsøvelsen	1	1	10-06-2015 00:23	SSN	15-06-2015 23:39	SSN
det har de ikke tid til (2)	2	2	09-06-2015 21:39	SSN	15-06-2015 23:39	SSN
det tager lige et par sekunder for meget	1	1	09-06-2015 20:36	SSN	15-06-2015 23:39	SSN
Fjerner intro-den ved krydset	1	1	10-06-2015 00:00	SSN	15-06-2015 23:39	SSN
Gør ikke det KpN beder dem om	1	1	09-06-2015 23:07	SSN	15-06-2015 23:39	SSN
Gå ned til fremgangsmåde	1	1	18-05-2015 10:41	SSN	15-06-2015 23:39	SSN
Går til NVM1 med det samme	1	1	11-06-2015 20:01	SSN	15-06-2015 23:39	SSN
Har ikke planlagt undervisning efter KpN	1	1	03-07-2015 21:34	SSN	03-07-2015 22:37	SSN
havde stoppet filmen hvis alene	1	1	08-06-2015 23:37	SSN	15-06-2015 23:39	SSN
læser og bruger kun det de SKAL	1	1	10-06-2015 00:00	SSN	15-06-2015 20:53	SSN
læser og følger ikke anvisningerne	1	3	09-06-2015 20:54	SSN	15-06-2015 20:53	SSN
ned til fremgangsmåde	2	5	08-06-2015 23:39	SSN	15-06-2015 20:53	SSN
se en fejl i tjeklisten.	1	1	11-06-2015 19:46	SSN	15-06-2015 23:39	SSN
Skal bare igennem- vigtigere end at lære	1	1	15-06-2015 20:12	SSN	15-06-2015 23:39	SSN
Vil ikke læse for meget af listen - bliver nødt til det (fremgangsmåde)t (No	1	1	09-06-2015 19:34	SSN	15-06-2015 23:39	SSN
arbejder meget bevidst	2	2	30-06-2015 17:24	SSN	07-12-2015 12:31	SSN
derfor er hun meget forberedt	1	1	08-07-2015 01:29	SSN	08-07-2015 01:29	SSN
ekstremt velforberedt	1	1	30-06-2015 17:07	SSN	30-06-2015 17:07	SSN
er meget forberedt	1	1	30-06-2015 17:03	SSN	30-06-2015 17:03	SSN
kører øvelsen slavisk igennem	1	1	11-06-2015 20:23	SSN	15-06-2015 20:15	SSN
Meget forberedt	1	1	30-06-2015 17:04	SSN	03-07-2015 22:44	SSN
meget koncentreret	1	1	11-06-2015 19:52	SSN	15-06-2015 20:53	SSN
meget optaget af det (Nodes)	1	1	30-06-2015 17:10	SSN	03-07-2015 22:43	SSN

Table 6 enlists the core categories, offers a basic description of each, and indicates where they will be further analyzed in the dissertation.

Table 6. High-Level Description of Core Categories

Core Category	Description	Addressed in…
Effect	Observations and statements on how KpN is impacting the teachers and their teaching	Chapter 8
Evaluations of KpN	Participants' statements on their perception of KpN	Chapter 8
Researcher's role	The teachers as well as the researcher noted that the researcher played an important role and had an impact upon the learning process.	Chapter 8

Strategies	The way in which the teachers responded to KpN in talk and action are multi-faceted and complex. This category expands the initial theory construction on strategies in Article A, Section 2.1.	Chapter 9.1
Language	There seems to be a clear divide in the teachers' narratives about KpN. Will be part of "Strategies."	Chapter 9.1
Approaches	There seems to be a clear divide in how the teachers approach KpN in terms of structure and patience. Will be part of "Strategies."	Chapter 9.1
Collaboration	The KpN collaboration between the teachers seemed to not solely promote changes to practices. Will be part of "Strategies."	Chapter 9.1
Learning process	The teachers expressed certain emotions/ reflections during certain periods of time in the learning process. Most prominent was the frustration during the initiation of changes in teaching.	Chapter 9.2
Students	The students became confused by the change in teaching; they need to learn/change as well. Will be part of the discussion on teacher frustration.	Chapter 9.2

Chapter 8 will follow up on the Word and Excel analyses presented in this chapter. The three core categories listed first in Table 6 will serve to inform the discussion of the findings from this analysis.

CHAPTER 8. EVALUATING EFFECTIVENESS

The first part of this chapter primarily addresses the dissertation's first research question: To what extent are oPDIs effective in advancing work practices? This part presents the findings arrived at through a quantitative analysis using descriptive statistics on the observation and survey data. Each chart is accompanied by details on the method by which it is derived, if not included previously in Section 7.4. Additionally, the results in this chapter are informed by the core categories "Effect" and "Evaluations of KpN." Many of the findings presented here were delivered as an evaluation report to the KATA Foundation in July 2014.

The second part of the chapter is a critical discussion of strengths and weaknesses in different approaches to evaluating oPD effectiveness. The results from the descriptive analysis are discussed as an extension of the critical discussion initiated with the findings on the evaluation of effectiveness in Article A (the literature review).

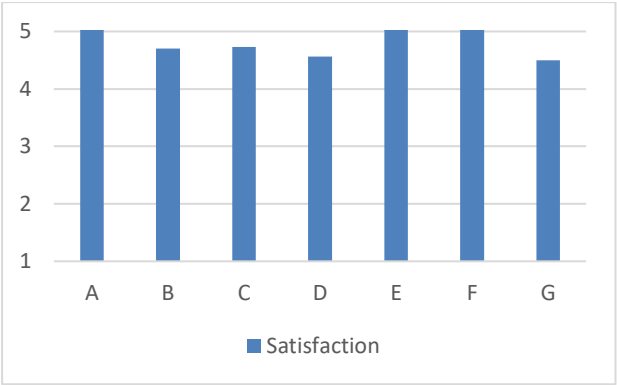
8.1. A DECRIPTIVE STARTING POINT

The following sections present and discuss findings on the teachers' satisfaction and their observed and self-assessed performance on behavioral learning objectives.

8.1.1. TEACHER SATISFACTION

The seven teachers responded to 31 questions and statements on the satisfaction survey; 17 of these questions were rated on a 5-point Likert scale, and 14 called for free-text answers and comments. Averaging the 17 Likert scale ratings for each teacher produced the results depicted in Figure 10. The teachers' names are replaced by letters A–G. The groups at the three schools consisted of Teachers A and B; teachers C, D, E; and Teachers F and G, respectively.

Figure 10. Average Teacher Satisfaction Ratings by Teacher

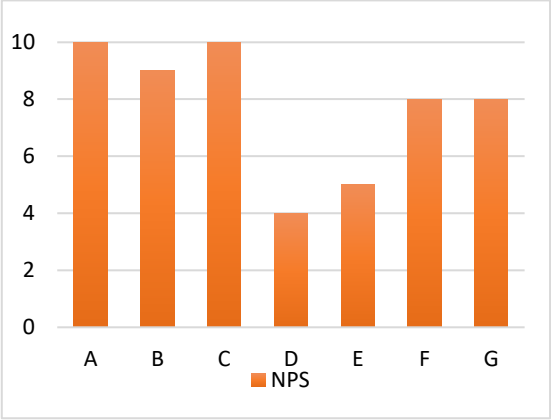


Looking at the individual questions and comments, the teachers' ratings were quite similar. Their comments indicated that the teachers were positive in terms of the completed PD process, the KpN content, and their expectations about changing their teaching practices; they stated that they wish to apply what they have learned in KpN and that they believe that doing so will improve their teaching. The lowest scores are given to the transfer environment at the schools; in particular, teachers had relatively low expectations about getting the time needed to change (teachers gave this element a rating of 3, on average).

This issue was further established with the results of the Net Promoter Score (NPS), which was included as an additional question in the survey. First introduced by Reichheld (2003), the NPS is another method for evaluating participant satisfaction (originally "customer loyalty and satisfaction"). Despite concerns about certain elements of the NPS formulation, use of NPS has become popular due to its simplicity and the ability to compare across interventions and organizations (Grisaffe, 2007). The NPS is calculated based on a single question; for KpN, the question was: How likely is it that you would recommend KpN to a friend or colleague? Participants answered on a 0–10 scale. The teachers' responses are shown in Figure 11.

Figure 11. Teacher Responses to NPS Question

How likely is it that you would recommend KpN to a friend or colleague?



Participants with ratings 0–6 are defined as *detractors*. Participants with ratings 7–8 are termed *passives*, and participants with ratings 9–10 are termed *promoters*. NPS is calculated by subtracting the percentage of promoters from the percentage of detractors. A positive NPS is considered good, but NPS has to be above 50% to be outstanding. KpN1 has a NPS of 14%. This score itself brings little valuable information for the dissertation research, but after comparing the two detractors' individual scores with their satisfaction scores in Figure 10, their low NPS scores are surprising. During the reflection session in the POST-phase, teachers C, D, and E discussed their NPS rating. While Teacher C had not considered the time allocated in her rating, Teachers D and E stated that they had rated KpN low on the NPS score because they would only recommend the course if sufficient time were allocated. They had not initially understood that they would be paid for time spent on KpN; when they learned this, they wanted to change their rating to a much higher one. The issue of time allocation is a recurring theme in the context of Danish school teachers' practices.

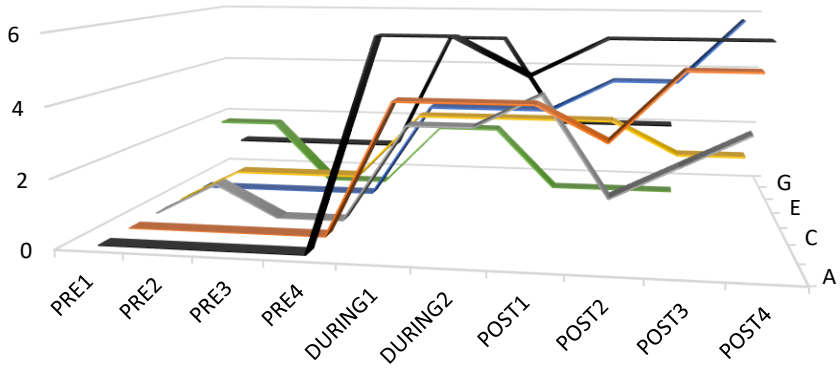
8.1.2. QUANTIFYING TRANSFER

Section 7.4.2 described how teachers' performance on the learning objectives was rated on a 6-point scale. It is important to note that "performance" refers to the extent to which KpN behavioral objectives were reflected in the teaching – not to the teaching performance per se. Figure 12 includes a table showing the ratings and a chart showing the teachers' performance curves through the individual classes of the PRE-, DURING-, and POST-phases. Charts have been created for each of the four courses as well as for all courses together. Figure 12 depicts the latter – the two courses each teacher completed. This is done despite the fact that only the course "Inquiry-based Method" was completed by all. As such, each rating is an average of

the two courses. This combined table was chosen because the three groups of teachers primarily focused on applying only one of the courses; thus, when looking only at the "Inquiry-based Method" course, it appears that some teachers did not initiate change, whereas they did initiate change in the other course they completed. For this reason, it seemed more appropriate to look at the courses together, which means comparing courses with similar structure but different content and objectives.

In the chart in Figure 12, the rating scale is depicted along the y-axis. Along the x-axis, each of the in-class observation sessions is listed (PRE1–4, DURING1–2, POST1–4). There were no POST4 observation sessions for Teachers F and G. It should also be noted that teachers C, D, and E were only observed during one session in the DURING-phase (DURING1). The same rating has been inserted in the DURING2 field in order not to break the curve.

Figure 12. Ratings of Teacher Performance on Learning Objectives: All Courses



	PRE1	PRE2	PRE3	PRE4	DURING1	DURING2	POST1	POST2	POST3	POST4
A	0	0	0	0	6	6	5	6	6	6
B	0	0	0	0	4	4	4	3	5	5
C	0	1	0	0	3	3	4	1	2	3
D	0	1	1	1	3	3	3	3	2	2
E	0	0	0	0	3	3	3	4	4	6
F	2	2	0	0	2	2	0	0	0	
G	1	1	1	1	5	5	2	2	2	

The performance curves in Figure 12 illustrate how the teachers show little to no performance on the learning objectives in the PRE-phase. Teachers F and G do perform on some of the objectives. They focused on the course "Language and Terms

in Science," and all of the teachers did use some of the language and terms taught in this course in the PRE-phase (the teachers were rated on all objectives, even for the courses they did not complete), but only the performances of Teachers F and G on these objectives is included in the chart. The ratings of the DURING- and POST-phases relative to the PRE-phase show the teachers' transfer of learning in terms of the behaviors aimed for with the learning objectives of KpN. In the DURING-phase, all teachers increased their performance on the objectives, though to a varying degree. In the POST-phase, however, the picture gets blurred, and the variation is striking. An average of the teachers' performance in the POST-phase would show a drop, which can be discussed in relation to an established body of research on what Fullan (2001) has coined the "implementation dip," which is further discussed in Article C in Section 9.2.1. An average would, however, erase the POST-phase variation, which is viewed as critical for investigating the effectiveness of KpN in advancing teaching. Chapter 9 is dedicated to unfolding this variation and complexity. At that juncture, more data will be brought in to discuss the measurements of effectiveness.

8.1.3. OBSERVATION VS. SELF-ASSESSMENT

Article A discussed the validity of self-assessed behavior change (Article A, Section 2.1). The data arrived at in RS2 enables a comparison between self-assessed behavior change and observed behavior change on the learning objectives of KpN. Figure 13 shows how the teachers evaluated their performance on the objectives in the PRE-phase (PRE1-4 in Figure 12) versus the POST-phase (POST1-4 in Figure 12). The data are an average of each teacher's responses to the retrospective behavioral questions in the identical PRE- and POST-surveys. The questions pointed to their performance on the behavioral objectives in the specific classes in which the observation also took place.

Figure 13. Teachers' Self-Assessed Performance

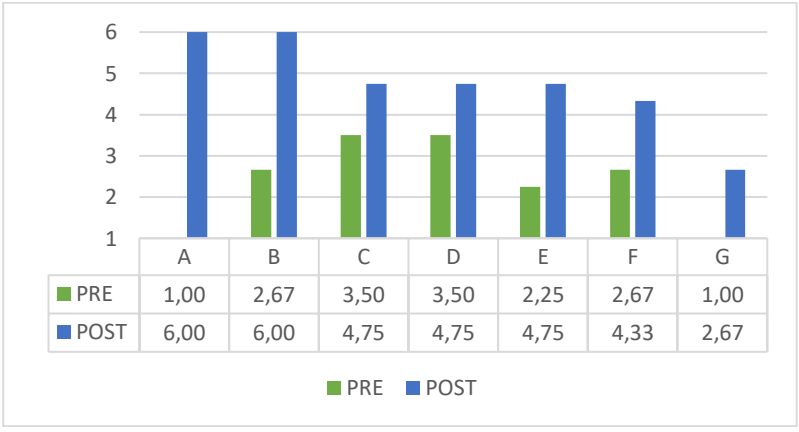
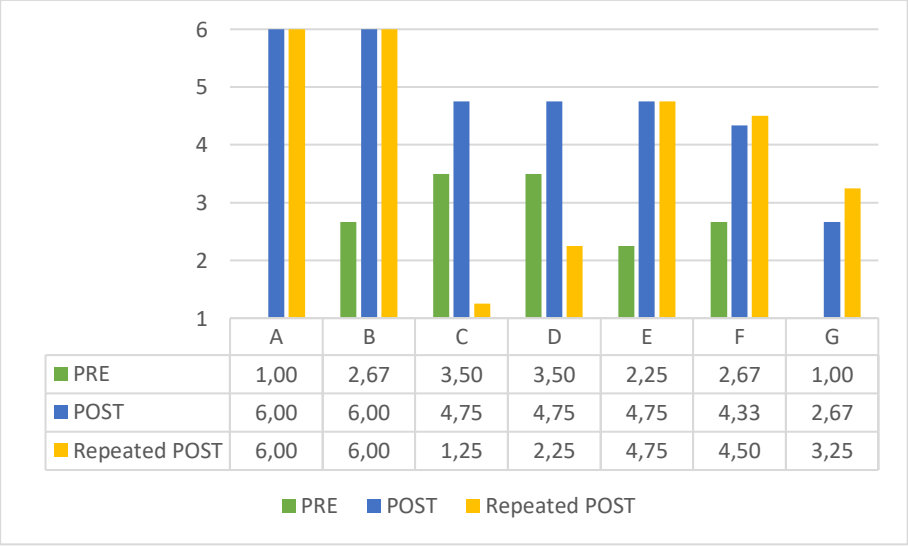


Figure 13 does not show the same variation as the chart in Figure 12, which has to do with only two data points in the self-assessment compared with 10 observation sessions. The teachers were, however, asked to consider all classes in the PRE- and POST-phases when answering the surveys. A comparison of Figure 13 with Figure 12 indicates either that teachers overrate their performance or that the researcher under-rates their performance when observed; Teacher A is the only one whose observation and self-assessment are identical. Nevertheless, comparing the PRE and POST observations ratings in Figure 12 with the self-assessments, the tendencies for each teacher are similar; those teachers rated high in the POST observation (teachers A, B, and E) have a high self-assessment. With the exception of teacher F, the other teachers' ratings can also be recognized in the curves. The self-assessed ratings of Teachers C and D are equal to Teacher E's, but in the performance curves, Teacher E's performance on the objectives is substantially higher toward the end. The similarities in observation and survey ratings were indicated in Article A (Article A, Section 2.1), and the likelihood that self-assessments are as valid as observations, together with the tendency to over-rate oneself in self-assessment, are well-established in literature (Ross, 2006). KpN thus supports that self-assessments can be valid indications of behavior change when they include retrospective behavior questions with free-text answers, provided that certain responses are not sanctioned or rewarded.

Figure 14 depicts teachers' self-assessed performance ratings after the addition of data from the repeated POST-survey.

Figure 14. Teachers' Self-Assessed Performance
Incl. Repeated POST-Survey



	A	B	C	D	E	F	G
PRE	1,00	2,67	3,50	3,50	2,25	2,67	1,00
POST	6,00	6,00	4,75	4,75	4,75	4,33	2,67
Repeated POST	6,00	6,00	1,25	2,25	4,75	4,50	3,25

The repeated POST-survey appears to confirm the tendencies presented in the chart in Figure 12 more strongly than the POST survey. Teacher G rated himself higher on the course "Inquiry-based Method" than he is given credit for in Figure 14; his free-text descriptions of his classes and knowledge of the course objective revealed that he did not understand the inquiry-based method and did not apply the method in his teaching. This indicated a seemingly obvious connection between understanding (learning outcome) and transfer: only by understanding the actions to be taken can you initiate them (Wahlgren & Aarkrog, 2012). Teacher F's statements indicated that she had not understood the inquiry-based method either but had nevertheless structured her class according to the method, thus performing on the objective. According to her self-assessment in the POST-survey, F had initiated change to a larger extent than teacher G. It is possible that she had sustained her new ways of teaching, but her theoretical knowledge gained with KpN had diminished; Hagen et al. (2011) noted a similar occurrence with participants in a security oPDI, as mentioned in Article A. Again, however, there is a mismatch between teacher G's performance curves and self-assessment. There is no obvious explanation for the discrepancies and no knowing whether the observation ratings or self-assessments are inaccurate; this emphasizes that perspectives may differ and be equally valid, and it underlines the complexity in capturing contextual change.

Unlike teacher A, Teacher B is likely overrating his performance from the position of the PhD researcher. It is, however, apparent that both teachers have integrated the KpN behaviors in their teaching practices. This was also confirmed during Jesper Ingerslev's later visits to the school. In addition, all of the other science teachers at the school completed KpN with the assistance of Teachers A and B.

For teachers C, D, and E, who completed KpN as a group at their school, the ratings in the repeated POST-survey corresponded with the observations. This variation between two groups of teachers in similar contexts will be discussed further in Article E in Section 12.1 of the dissertation.

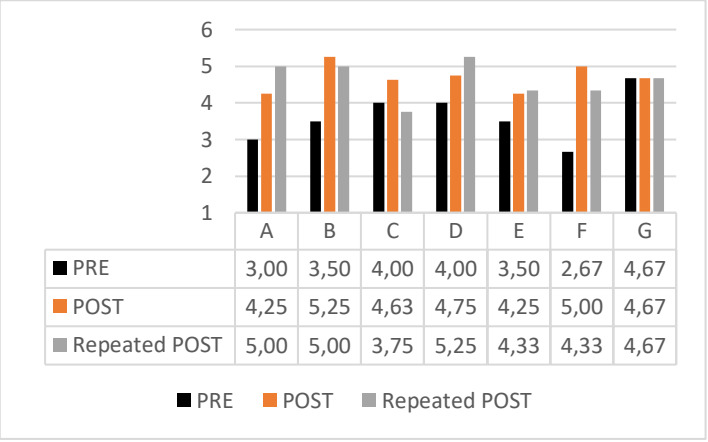
The teachers' responses to the surveys may have been influenced by them knowing that the researcher was present in the classes referred to in the surveys. Thus, some teachers may have been careful not to overrate themselves, while others may have been biased toward overrating themselves to show their progress. This is speculative, but it calls into consideration the context dependencies of surveys and observations, including the researcher's role in advancing practices.

Important to the comparisons between observation and self-assessment are, again, the different positionings of the teachers and the observing researcher. Though it may be tempting to state that observation is "more correct" due to potential say-do-conflict by the teachers, the observations should be viewed as researcher narratives, which are equally biased. The reason for giving observation materials weight is that when choosing between observation and self-assessment is necessary, observation provides richer data, both in time and depth.

8.1.4. A SIDE NOTE ON SELF-EFFICACY

In working with the teachers at the schools, I observed that those teachers who expressed low self-efficacy on performing on KpN objectives before the KpN program went through the greatest change. Comparing the PRE-self-efficacy in Figure 15 with the self-assessed performance in the repeated POST-survey in Figure 14, the teachers with the lowest self-efficacy rating before KpN (Teachers A, B, and F) were indeed those with the highest self-assessed performance, and vice versa for the remaining teachers. Future studies might investigate this hypothesis further, as research on self-efficacy is generally focused on how high self-efficacy post-intervention increases performance (Bandura, 1977; Torkzadeh, Pflughoeft, & Hall, 1999; Usher & Pajares, 2007). The focus in this dissertation is, however, to dive into variation in the narratives to add body to these initial findings.

Figure 15. Self-Efficacy per Teacher



	A	B	C	D	E	F	G
PRE	3,00	3,50	4,00	4,00	3,50	2,67	4,67
POST	4,25	5,25	4,63	4,75	4,25	5,00	4,67
Repeated POST	5,00	5,00	3,75	5,25	4,33	4,33	4,67

8.2. WHAT ARE WE MEASURING?

This second part of Chapter 8 extends the critical discussion on measuring oPDI effectiveness in advancing practices.

8.2.1. DISSATISFACTORY SATISFACTION

In the satisfaction survey, the teachers expressed KpN's positive influence on their teaching. Yet the performance curves showed highly diverse transfer of learning to their practices. Figure 16 shows that the satisfaction survey, as is generally the case with satisfaction surveys, was conducted after the conclusion of KpN and before the commencement of the POST-phase (red vertical line in Figure 16).

Figure 16. Satisfaction vs. Observations

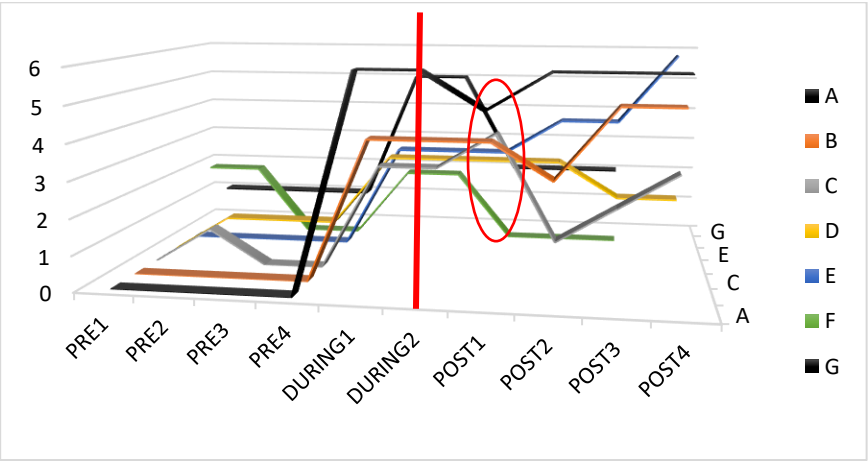


Figure 16 highlights a concern with evaluating effectiveness of oPD on participants' satisfaction or anticipations at course completion. As was the case with the KpN teachers, participants in oPD may be very satisfied and motivated at course completion, but it is after the course that the hardest challenges lie. When the satisfaction survey was conducted, the only difference in the performance curves was the level to which they applied the objectives; but after the survey, the curves changed, sometimes dramatically, illustrating how lived practices bring challenges and opportunities a structured and facilitated course will not – even when the course entails in-class teaching, as was the case with KpN1. Why do we see this diversity in the POST-phase? What are the teachers experiencing? The grounded analysis showed that the extent to which teachers experienced frustration in the POST-phase (red oval in Figure 16) appeared to influence the extent to which they sustained the initiated change to teaching. Chapter 9 unfolds this discussion. For now, the validity of satisfaction surveys in evaluating the effectiveness of oPD is brought into question,

implying that evaluation requires multiple data points in the transfer of learning process. Due to the diversity and fluctuation in the performance curves, it is suggested that formative evaluation is made continuous in order to follow participants' individual learning journeys and support accordingly. This point will be revisited throughout the remainder of the dissertation.

8.2.2. RESEARCHER'S ROLE

This section primarily draws on the core category "Researcher's role" from the grounded analysis, which includes all qualitative data on this topic. However, it was immediately clear from the positive free-text comments in the satisfaction survey that many of these comments referred to the researcher's facilitation and coordination in RS2, in particular the reflection session in which teachers observed and commented on their own and each other's teaching. As the PhD researcher, I not only influenced the teachers' narratives about the KpN intervention, but the results on the transfer of learning were unavoidably influenced as well. With its DBR methodology, RS2 deliberately aimed to interfere and make a difference. It is nevertheless important to factor in and discuss this interference and this difference when evaluating the effectiveness of KpN.

In terms of the in-class observation, the teachers stated that the presence of the PhD researcher had had little or no impact on the students' and teachers' behaviors in-class. The observation notes do, however, often and quite clearly express that my presence did indeed affect the teachers' teaching behaviors. As an example, Teacher A became aware that I was evaluating the questions she asked the students in-class, even though she had not completed the course "Engaging Questions." She began asking questions differently and informed me that she could not help looking into that course as well (Observation notes, POST reflection session). More subtle impacts were also noted; for example, when Teacher C looked at me in the corner of her class, she immediately changed the way she posed questions to the students; it appeared that she changed her question in accordance with KpN when she paid attention to my presence in the class (Observation notes, in-class teaching, POST3, Figure 12, 16).

My presence during the teachers' interaction with the KpN content also became evident when Teacher E stated, "If you hadn't been here, we would have stopped this video after 10 minutes!" (Observation notes, interaction with KpN: Course: 'Inquiry-based Method'; Module:1).

In sum, the personal commitment to and the physical presence of the researcher affected the teachers and seemed to place on them an indirect pressure to prepare for and initiate change. The time and effort invested in the PDI work, as well as the initiated change, would likely have been reduced if the researcher had not facilitated and documented the process as intensely as was the case.

Personal facilitation does not by default influence the transfer of learning positively, however. Facilitation can be counterproductive and can potentially impede participants from taking initiative and accepting accountability, because the instructional and transfer scaffolding carries them through the process (Andersen, Garp, Nellemann, Nielsen & Ørngreen, 2014; Ørngreen, 2015). When the scaffolding is withdrawn in the POST-phase, the scaffold collapses, which could also explain a dip in the performance curves. In addition, the facilitation and scaffolding is not positive per se. Just as feedback can be critical to performance, it can also impede performance (Hattie & Timperley, 2007). Relatedly, teacher D, the most experienced teacher, appeared to become more insecure and uncomfortable at my presence in her classroom, though herself stated that it had no impact on her (Observation notes, In-class teaching, POST4, Figure 12, 16). The importance of scaffolding is discussed in Article E in Section 12.1. The KpN data are, however, indicative of the role of personal facilitation in increasing teachers' engagement with KpN, even if this engagement was not solely positive.

Even with the heavy coordination and facilitation, the extent to which teachers performed on the learning objectives varied greatly after the completion of KpN in the POST-phase, and great (though varying) effort appeared to be needed for KpN to be effective in changing teaching practices. The analysis of KpN effectiveness thus far points to a risk that without in-person coordination, supervision, and facilitation, KpN (like e-Learning more generally) will be engaged with, completed, or transferred only to a limited extent. This concern was raised to the KATA Foundation with the KpN evaluation report in July 2014.

8.2.3. PERFORMANCE ON OBJECTIVES – AN ADVANCEMENT?

There is no standard way to calculate transfer of learning. As an over-all calculation of KpN objective-based transfer of learning, this PhD research suggests dividing the sum of actual ratings by the sum of highest possible rating for the PRE-phase and POST-phase respectively. Thereafter, subtracting the PRE-result from the POST-result to get to the difference in performance between the PRE- and POST-phases. Multiplying with 100 enables the final result to be presented in percentage:

$$\left(\frac{\Sigma actual\ POST\ ratings}{\Sigma highest\ possible\ POST\ ratings}\right) - \left(\frac{\Sigma actual\ PRE\ ratings}{\Sigma highest\ possible\ PRE\ ratings}\right) x\ 100$$

Using this formula, the overall transfer of learning score for RS2 was 46%. Though no direct comparisons exist, Broad & Newstorm (1992) suggested that, in general, only 10% of learning from PDIs are transferred back to the workplace. Including this information in the KpN1 evaluation report delivered to the KATA Foundation resulted in the overall transfer of learning score becoming an easy-to-communicate indicator of KpN's effectiveness in advancing practices and reason to use KpN at scale. Two concerns should, however, be raised in this regard. First, RS2 showed that much of

KpN's effectiveness in changing teacher behaviors may have depended upon personal facilitation. This indicates that KpN might not be expected to uphold the overall transfer score as a scalable oPDI with no personal coordination and facilitation.

Second, even if the high transfer score would apply to the scalable solution, performance of the KpN learning objectives does not ensure advancements of practice; for example, posing "engaging questions" as defined in KpN does not necessarily mean that this positively affects student engagement. Also, the teachers may perform on the objectives, but they may not experience this as effective in advancing practices; Thus, not sustaining the change beyond the POST-phase. This again touches on the necessity of viewing effectiveness from different perspectives, at different times and in context. Chapter 9 picks up on these discussions as the descriptive statistics presented in this chapter are unfolded to better understand the conditions under which oPD can be effective in advancing practices.

8.3. KEY CONTRIBUTION

Chapter 8 aimed to contribute to answering the first research question: To what extent are oPDIs effective in advancing work practices? RS2 showed that all teachers made changes to their teaching practices after KpN, although to a varying extent and with very diverse transfer trajectories. The data indicate that the extent to which a teacher's performance meets learning objectives shortly after completion of the intervention is mirrored in the teacher's practice 6–9 months later. Thus, those teachers whose performance met the objectives to a large extent appeared to have sustained the behavior, whereas those teachers whose performance met the objectives to a lesser extent seemed to stop using KpN. This finding considers the likelihood that the teachers overrated their use of KpN at least slightly in the repeated POST-survey. Chapter 8 also established that changes in teaching may meet established learning objectives without necessarily advancing practices.

8.3.1. IMPLICATIONS FOR DESIGN

Chapter 8 raised the concern that oPD effectiveness in initiating change depends largely on teachers' personal commitment to the coordinator and facilitator. In addition, leaving it up to oPD participants to implement change after intervention is likely to fail. In KpN, teachers were supported through the initial change, as KpN entailed in-class teaching. Nevertheless, KpN failed to support several of the teachers sufficiently or in a manner that sustained the initiated change. Thus, it is suggested that participants require more individualized and contextualized support in a continuous manner instead of intensive facilitation and support for a short period followed by no support. Chapter 9 expands this discussion by investigating the participants' narratives and strategies to understand the conditions under which oPD can be effective in advancing practices.

CHAPTER 9. UNFOLDING PROFESSIONAL DEVELOPMENT COMPLEXITY

This chapter primarily addresses the second research question of the dissertation: When and under which conditions can oPDIs be effective in advancing work practices?

Section 9.1 unfolds the findings of the grounded analysis with respect to teachers' narratives and strategies in the process of intervention-based change, focusing on the core categories "Strategies" and "Language."

Section 9.2 focuses on a key finding in the core category "Learning process" regarding the frustration expressed by some teachers during the oTPD process. This topic is addressed by Article C, which is included in Section 9.2 with perspectives from the core category "Students."

9.1. TEACHER NARRATIVES AND STRATEGIES

Article A (Section 2.1) touched on the teachers' negotiations of KpN effectiveness while they interacted with the KpN learning content. During the transcriptions of Camtasia recordings from the teachers' interactions with KpN1, I found (read: constructed a narrative about) the teachers discursively negotiating whether or not to change their teaching. As part of the initial interpretations, attention was paid to three prevailing strategies applied by the teachers, seemingly to avoid changing their teaching. These were published with Article A:

1. "Find statements to reject content" means that the teachers appeared to be searching for single elements in the learning solution that they could use to prove that teaching in the suggested ways was unrealistic for their specific work context.
2. "Modify content to make change less demanding" refers to the teachers consciously or unconsciously modifying the content so that it either became the same as their current practice, allowing them to state that they were already teaching this way, or changing the content so it became easily applicable.
3. "Pinpoint content easily implemented" means that the teachers found elements of the content that they could easily apply to their teaching without changing it fundamentally.

(Noesgaard & Ørngreen, 2015)

Based on the performance curves and self-assessments presented in Chapter 8, two of the groups of teachers were of specific interest due to the variation in their performance on the KpN objectives. The first group included Teachers A and B; the second group included teachers C, D, and E. Therefore, these five teachers were included in the analysis when revisiting the data in the grounded analysis. This analysis brought attention to less salient teacher strategies and dynamics that had not received attention in the first analysis presented in Article A. Specifically, the descriptive analysis showed that several of the teachers changed their teaching profoundly due to their engagement with KpN. However, the discursive strategies teachers used to embrace the content of the KpN and subsequently change their teaching had not been identified, possibly because of researcher bias toward unexpected negative teacher narratives. To further understand the dynamics of intervention-based change, this section extends the strategies of avoidance noted above to uncover some of the nuances and complexities in the teachers' reactions to being challenged to change their teaching.

With social constructionism as an analytical frame, the goal of discussing teacher strategies is not to discover the intentions of the teachers; instead, the goal is to investigate narratives to which others react. Thus, the ways in which the teachers participate in the construction of oPD effectiveness are of special interest. Narratives are the utterances of teachers. These are grouped into strategies. Strategies should not be viewed as personal impulses, which are made social, but as social processes perceived as personal (Gergen, 1994). Consequently, strategies are groups of narratives which pull the social interactions on oPD effectiveness in a certain direction (acceptance – change vs. resistance – status quo). Strategies thus reflect what the narratives "do".

The data consisted of 231 notes in 25 categories under the core category "strategies". This data speaks to the ways in which the five teachers interacted during and after KpN. These 25 strategies were further categorized into "acceptance" and "rejection." Some of the 25 categories were so closely related that they were merged, resulting in a total of 14 strategies.

Table 7 depicts the 14 strategies. In addition to the number dedicated to the strategy, the first column shows an "Example" from the nodes, which resulted in the construction of the "Strategy." The third column shows whether the nodes consist of teachers' "Narratives" and/or researcher narratives based on "Observation." The fourth column shows whether the teachers appear to be using the strategy "Deliberately." The fifth column provides a "Reasonable Reason" for why the teachers may apply the strategy considering the kind of "Context" in which the nodes are mostly identified (column 6).

Table 7. Strategies in Intervention-Based Teacher Change Process

Example	Strategy	Narratives/ Observation	Deliberately?	Reasonable Reason	Context of
1 [A agrees that it takes a lot of time to use the suggested teaching method but says the teachers can have shorter periods of teaching in which they use the method, instead of structuring the whole teaching as per the suggested method.]	Adjust the course content to make it applicable in practice	Narratives	Yes	Easier to apply – less change needed	Acceptance
2 [C and D talk about a tool called "Wonderwall" introduced to them in the course. C: "We could make next year's curriculum on it – then *they* (students) have decided what to work on…" This is not what Wonderwall was intended for. At the school they are working on involving the students in the planning of teaching.]	Adjust course content to help with current tasks/challenges	Narratives Observation	Yes	More valuable	Acceptance
3 [B: "I am thinking about what was said (in course video) - that an open approach to the students' experiments creates a better understanding for them. I have put this part in brackets, because I do not always agree."]	"Bracket" elements of the course that do not reflect practice	Narratives	Yes	Should not impact the general learning experience	Acceptance
4 [D is working on posing more productive questions: She is adding "What do you think?" to her questions.]	Apply the easy-to-apply course elements into practice (as is)	Narratives Observation	No	Easier to apply – less change needed	Resistance
5 [A: "I will continue working on the Norwegian model and try to get it into every class."]	Commit to applying the course content in practice	Narratives	Yes	Wish to change	Acceptance
6 [E tells me that she has a good feeling about using the productive questions and that she has also used them in her history teaching today.]	Apply course content in other than intended contexts	Narratives	Yes	Extent benefits experienced to other teaching subjects	Acceptance
7 [C says that the teacher in the video said that applying the teaching method like they do in the video is good for the lower grades, but in middle school they can just talk with the students about how to use the method - not necessarily apply it. D and E nod in agreement. The teacher in the video did not say this. C, D and E are middle school teachers.]	Adjust course content to look more similar to practice	Narratives	No	Easier to apply – less change needed	Resistance

8 **[B begins by formulating a question with the students in plenum, then they find information in groups and he concludes by discussing their findings in plenum. To B, this is a very challenging, open way to teach. Apart from the formulation of a question in the beginning, B teaches in the way he normally does and uses the same kind of activities, but he has changed the sequence of activities, i.e., the structure of the teaching.]**	Continue previous way of teaching with the new structure recommended in course	Observation	No	Wish to change and keep own style – easier to change.	Acceptance
9 **[The teachers are challenged with two different courses and behavioural objectives, but they only work on one of them. They appear to forget that there is more than the course they are working on.]**	Pick one course/objective to apply in practice	Narratives Observation	No	Easier/more realistic	Acceptance as well as resistance
10 **[D: "This is unrealistic for my students."]**	Point out course elements not realistic/ applicable in practice	Narratives	Yes	Avoid change/ make change irrelevant	Resistance
11 **[The teacher (in the video) says that the students should write and draw what they plan to do and what they believe is the correct answer. B: "Write and draw what they think – I do that too in my teaching." B was observed asking his students to write and draw pictures but was not observed asking them to plan or hypothesize, which is the point of this part of the video.]**	Point out elements that are already part of practice	Narratives	Yes	No need to change Show that they do good things already	Acceptance As well as resistance
12 **[In the video, the teacher mentions that the students can present the results in a play. D: "In a play? – as if!" All three teachers laugh.]**	Ridicule the course content	Narratives	Yes	Show that content should not be applied/is irrelevant	Resistance
13 **[D says that she was in doubt about when to ask the questions she had prepared, and when she did, she didn't feel it worked well – she was not satisfied with the flow in her teaching. It was awkward!** **In the teaching that D refers to and in the teaching, that followed, it seemed to have a negative effect on the teaching that she was performing the course objective.]**	Apply elements of course content – teaching becomes awkward	Narratives Observation	Yes	Show that content does not work	Resistance
14 **[I ask E after her teaching how she is working with the inquiry-based method. She says that she is not. She is focusing on the productive questions. I noticed that E is indeed teaching as per the inquiry-based method, which she did not do previously.]**	Apply elements of course content unknowingly	Narratives Observation	Yes No	Deliberately underreport own commitment to change The courses support same change.	Acceptance as well as resistance

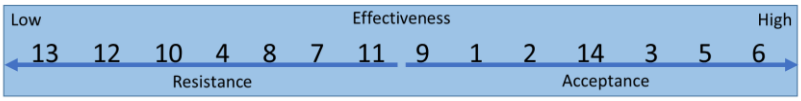
The strategies add a layer of complexity to the traditional perceptions of the transfer of learning; the teachers did not transfer anything directly, but instead they engaged in negotiations of the effectiveness of KpN1, and as a result, they recontextualized KpN in their practices in a way that appeared to modify either KpN or their teaching accordingly. In addition, the transfer of learning as per learning objectives may result in teaching becoming more "awkward," leading to considerations on PD interventions potentially worsening practices (Teacher D, Strategy 13). On the other hand, advancements to practice may also surpass the intended boundaries as new intervention-based competencies are applied in other contexts (Teacher E, Strategy 6).

Chapter 8 illustrated how, from the researcher's perspective, most of the teachers overrated their performance on the objectives. Notes from the reflection sessions and teachers' interactions with KpN indicated that, in many instances, the teachers perceived that they had changed their teaching substantially more than my classroom observations evidenced. It should be noted that the teachers' opportunities for comparing teaching was limited to the video segments showed in the reflection sessions. In addition, narratives pointing to the reverse were also present; as the researcher, I reported substantial changes regarding objectives where the teacher in question did not report the same (Teacher E, Strategy 14).

The strategies listed in Table 7 illustrate how teachers negotiated the (potential) effectiveness of KpN in advancing their practices and thereby negotiated the need to change. Perceiving a strong, urgent need to change is critical to the commitment to change, the initiation of change, and the sustainment of change (to be discussed in Chapters 11 and 12). Hence, the strategies hold explanatory power for the behavioral changes and the advancement of practices (or lack thereof).

Table 7 shows a wide spectrum of strategies. In Figure 17, the strategies, represented by their numbers from Table 7, are placed on a continuum. Though simplified, the continuum illustrates that the strategies represent different degrees of negotiating KpN to be ineffective (resistance) or effective (acceptance).

Figure 17. The Effectiveness of KpN Related to Strategies



Teachers C and D are exponents of most of the strategies of resistance (13, 12, 10, 7, 4). These strategies belong to the left side of the continuum (Figure 17), where KpN ineffectiveness is negotiated for. Both teachers do, however, represent Strategy 2, "Adjust course content to help with current tasks/challenges," indicating that KpN's effectiveness (from their positions) depends on the extent to which it is effective in

assisting and potentially saving time in relation to already existing tasks and challenges.

In contrast, Teachers A and B only applied the strategies of acceptance. As Section 9.2 will show, however, this should not be taken to indicate an easy teaching transformation process for teacher A.

Taking another look at the performance curves and teachers' self-assessments in Chapter 8, use of strategies of resistance or acceptance appeared to be related to teachers' performance on the behavioral objectives of KpN in the POST-phase (Figure 12, 16). Teacher E's use of strategies should be given extra attention due to her narratives being an exception to this picture. When interacting with the researcher, students, and content individually, she applied strategies of acceptance (Strategies 6 and 14). When interacting with Teachers C and D, she applied strategies of resistance (Strategies 12 and 7). KpN was designed for teachers to reflect together and collaborate because KATA wished to encourage teachers' professional communication and collaboration, which is minimal at many schools (Noesgaard, 2014). During RS2, the teachers did appear to learn substantially from the collaboration (e.g., by using each other's material and getting inspired by certain didactical tools the others used). Teacher E's use of strategies in the teacher collaboration group does, however, nuance the tendency to view collaboration solely as a promoting factor for learning and change. When research states, for instance, that collaboration between teachers involved in change can help sustain motivation (e.g., Lieberman & McLaughlin, 1992), the opposite may be equally true. In the case of Teacher E, the collaboration between Teachers C, D, and E appeared to make Teacher E conform to the group narratives of resistance. For this reason, Teacher E may have deliberately underreported her commitment to the teaching change (Teacher E, Strategy 14). Teacher E did, however, change her teaching substantially, apparently because she experienced the initiated change to be effective in her teaching. This indicates that in-class evidence of KpN's effectiveness in advancing teaching trumps a collaborative climate of resistance.

The students' influence on the perceived effectiveness of KpN is discussed in Article C in Section 9.2. The teachers' narratives on the students also link to the strategies. Teachers who primarily engaged in strategies of resistance attributed any stated impossibilities in changing teaching as per KpN, as well as negative outcomes of their efforts, to external circumstances. The external circumstances the teachers pointed to included inadequacies of the TPD, lack of time to implement the TPD, an unsupportive school culture, and a need to be true to their own teaching style. The argument that they need to be true to their own teaching style is commonly advanced by teachers (e.g., Noesgaard, 2014). Unfortunately, this insistence may impede their capacity to meaningfully reflect and grow professionally (Ball, 1997). The external circumstances often involved challenges with students or students' need of a different structure than the one suggested in KpN. Teachers engaging in strategies of acceptance, on the other hand, defined their challenges as the result of their own

incompetence and need to change. This was especially true for Teacher A, who underwent the greatest change in the KpN oPD process.

In sum, the teachers' socially constructed narratives and strategies reflects negotiations of the effectiveness of oPD, which, in turn, influences teaching and the potential advancement thereof.

9.2. A POTENTIALLY FRUSTRATING LEARNING PROCESS

The grounded analysis found a variety of narratives and events that described the learning processes of the seven teachers in RS2. Of special interest was the data linked to the variation in the learning trajectories depicted in the performance curves in Chapter 8 (Figure 12, 16). The category of "Frustration" during the initiation of changes in classroom teaching was most prominent at the critical time following the intervention; teacher frustration in the implementation appeared critical to the possibilities of changing practices. Article C specifically investigates the definitions, causes, consequences, and practical implications of teacher frustration as illustrated by Teachers A and D. The importance of students' reactions is addressed as well.

9.2.1. ARTICLE C

Teacher Frustration in Professional Development: Causes, Consequences and Practical Implications

Author: Signe Schack Noesgaard

This manuscript has been submitted to the journal *Professional Development in Education*, December 2016.

Teacher frustration in professional development: Causes, consequences and practical implications

Signe Schack Noesgaard

The KATA Foundation, Alsion 2, 6400 Sønderborg, Denmark & Aalborg University, Department of Learning and Philosophy, It & Learning Design Lab, A.C. Meyers Vænget 15, 2450 Copenhagen SV, Denmark. Tel.:+45 21789474; E-mail address: ssn@learning.aau.dk

ABSTRACT

The influence of frustration on the effectiveness of teacher professional development has previously been overlooked. This study of in-service teachers who become frustrated during professional development interventions considers the development of two Danish science teachers. Frustration theory is expanded with situated learning theory to illuminate some of the complexities of teacher frustration found in the empirical case. Through multiple new perspectives on the field, the study conceptualizes transformative and regressive frustration to illustrate how frustration operates at the tipping point of teacher change. At a practical level, the effectiveness of teacher professional development in advancing teaching is shown to be unpredictable, requiring individualized and timely support.

Keywords: Professional development; teacher change; frustration; situated learning, implementation

1. Introduction

Teacher professional development (TPD) is often perceived as a cornerstone of efforts to improve elementary schools and the quality of teaching they deliver (Borko 2004; Guskey 2002b). There is general agreement within the field that the purpose of TPD is to transform teachers' beliefs about learning and their instructional practices in the interests of their students' growth (Avalos 2011; Dede *et al.* 2008; Guskey 2002b; Sprague 2006). The term *TPD* is used here to refer to any such formalized and

structured competence development interventions for in-service teachers. These may include explicitly planned materials, courses, seminars, coaching or mentoring of any duration, structure, combination or delivery method.

Despite high levels of investment in TPD, teachers recurrently express their frustration with TPD, which is frequently perceived as irrelevant and ineffective in improving their core work—helping students learn (Bill & Melinda Gates Foundation 2014; Borko 2004; Dede *et al.* 2008; TNTP 2015).

The conclusions of research into the effectiveness of PD are mixed; more than 40 randomized controlled trials within the last 10 years have robust positive findings, yet many do not, and explanations of why TPD is or is not effective vary widely. Of the studies pointing to TPD ineffectiveness, explanations range from school cultures with low expectations of teacher performance, undermining required change (TNTP 2015), to a lack of coherence across TPD interventions, which are inconsistent with teachers' goals or standards and assessments (Garet *et al.* 2001). A large group of studies centers on the influence of designs and executions of specific TPD interventions on TPD effectiveness (Borko 2004). An extensive field within TPD investigates the difficulty of TPD implementation (e.g. Fullan 2001). This article contributes to this field, suggesting that some TPD interventions may fall short in improving teaching because of the unpredictability of teachers' frustration as they struggle to improve their teaching methods in line with TPD interventions.

Frustration has not been rigorously conceptualized as a factor in the effectiveness of TPD or of professional development more generally. The present paper is an attempt to conceptualize teacher frustration in implementing TPD to explore both the learning potential of frustration and how it potentially undermines the effectiveness of TPD interventions. This deep-dive into the classrooms of two frustrated Danish K9 science teachers will augment existing research to understand the causes, consequences and practical implications of teacher frustration. Referring respectively to frustration theory and self-affirmation followed by a critical modifying perspective of situated learning theory, the paper addresses the following four questions.

(i) What defines teacher frustration?
(ii) What causes teacher frustration?
(iii) What are the consequences of teacher frustration for teacher change?
(iv) What are the practical implications of teacher frustration?

2. Extant research on frustration

The research on frustration encompasses multiple fields and subjects. A large number of studies within cognitive neuroscience investigate the relationship between frustration and aggression (e.g. Berkowitz 1989; Fishman 1965; Nickel 1974; Pawliczek *et al.* 2013; Yu *et al.* 2014). In an organizational context, Sassi *et al.* (2015) suggested that organizations can reduce frustration levels among blue-collar workers by reducing quantitative workload, role ambiguity and interpersonal conflicts, and by increasing workplace sensitivity to early signs of frustration. Fox and Spector (1999) found a positive relationship between employees' experiences of situational constraints (that is, events frustrating achievement of organizational and personal goals) and counterproductive behavioral responses. Research on frustration has also investigated such topics as frustration with computing (Bessière *et al.* 2006; Lazar *et al.* 2006a; Lazar *et al.* 2006b), frustration in online education courses (Hara and Kling 1999; Harrington 2005; Jibeen 2013) and intelligent IT systems that predict and reduce frustration (e.g. Hone 2006; Kapoor *et al.* 2007; Klein *et al.* 2002). But despite this ongoing interest and widespread use of the term, studies of teacher frustration remain limited. Sutton (2007, p. 259) is one of the few who describe teachers' frustration in their everyday work with students:

> Frustration and anger arise from a number of sources related to thwarted goals including students' misbehavior and violation of rules, factors outside the classroom that make it difficult to teach well, uncooperative colleagues, and parents who do not follow appropriate behavior norms or are perceived as uncaring and irresponsible. Teachers also become angry when they believe that

students' poor academic work is due to controllable factors, such as laziness or inattention.

According to Sutton (2007), teachers' frustration negatively impacts their concentration in many cases. Students are the immediate target of that frustration, which Sutton suggests has a negative effect that persists well beyond the specific episode of anger and frustration.

Unlike extant research, this article focuses on teacher frustration with TPD initiatives. It takes outset in the behaviorist lens of frustration theory, where frustration is a response to 'nonreward in the presence of anticipated reward' (Amsel 1992). According to this view, frustration is the blocking of reward for goal-directed behavior. Self-affirmation theory is included to divert the focus to possible psychological mechanisms causing frustration. Because of the findings of the empirical study presented in the article, these perspectives are nuanced by situated learning theory, bringing attention to the contextual dependencies of teacher frustration.

3. Empirical study

The empirical study reported here investigated a TPD intervention developed for Danish elementary school science teachers and designed to increase student engagement through implementation of inquiry-based teaching methods. Although the performance of Danish elementary school students in science is above the international average, students' attitudes regarding science teaching are largely negative. In general, they do not understand the purpose of the teaching, and they lack confidence in learning the natural sciences (Aarhus University 2011). In addition, Danish society is challenged by the fact that young people are less inclined than those in other countries to pursue an education or a career in the natural sciences (Egelund 2007).

Teachers are the most influential factor in elementary school students' performance and motivation (Hattie 2011; Hattie 2014). In Denmark, however, as many as 70% of teachers who teach elementary school science had never received any formal training in science teaching (UVM 2009). In 2012, the Danish government

acknowledged this challenge and set the goal that all students in public elementary schools must be taught by teachers with a specialization in the topic taught (Ministeriet for Børn og Undervisning 2012). In 2013, the KATA Foundation—a non-profit project foundation dedicated to improving elementary school science—decided to address these issues by developing a free online learning platform for the 6,000 Danish elementary school teachers who teach science. Unique in a Danish context, this online platform is intended not to replace formal training but to support science teachers with no specialization in the natural sciences in meeting everyday teaching challenges.

3.1 TPD intervention

The TPD intervention in question here involved a blended learning process facilitated through the KATA online learning platform depicted in Figure 1. The competence development process included a) the interaction with theoretical content and practical tools, delivered through videos, guided animations and quizzes; b) guided preparation for in-class practical training; c) the actual in-class practical training; and d) reflection exercises on their own teaching before and after each practical training session.

The learning process and content was specifically designed to maximize transfer of learning, ensuring high relevance to classroom practice through participatory development, with practice of concepts during and after instruction and opportunities for systematic reflection (Noesgaard and Ørngreen 2015; Wahlgren and Aarkrog 2012).

The intervention had four courses, each with 7–10 modules (Fig. 1). Each module was based on learning objectives such as ‘The teacher understands engaging questioning’ for theoretical modules, and behavioral objectives such as ‘The teacher asks engaging questions’ for practical training modules. The platform specifically guided a learning process in which teachers first reflected on their current practice and then interacted with short learning modules. Each of these modules focused on one key learning objective, which teachers subsequently integrated in their preparation and teaching, following detailed procedural guidelines. In each case, the teachers

returned to the platform to complete a collaborative reflection exercise on implementation of the learning objective before moving on to the next module.

Figure 1. *TPD intervention: Content and structure*

4. Research study

A five-year design-based research (DBR) study was initiated alongside development of the platform (overview in Ørngreen *et al.* 2016). This paper reports the first in-depth qualitative study, involving the first seven teachers to complete the intervention in 2014. The overall aim of this study was to understand the complexity of transforming teaching by asking if, how and why the TPD intervention impacted science teaching practice. The research question was deliberately left quite open to

allow for nuances and unforeseeable issues at this early stage of the broader DBR project.

4.1. Data collection

Empirical data were gathered from February 2014 to May 2015. The primary data comprised extensive in-class video recordings and observations over the first five months of the study period (February–June 2014). Ethnographic and survey data were gathered in identical ways before and after the participating teachers interacted with the online platform, as illustrated in Table 1.

Table 1. *Data collection overview*

	Pre phase (Feb. 2014–April 2014)	**TPD phase (April 2014–May 2014)**	**Post phase (May 2014–June 2014)**	**Follow-up (Dec. 2014–April 2015)**
Teacher Activity	Preparation and teaching as normal	Alternation between online modules, preparation and teaching as per guidelines in modules	Preparation and teaching without TPD requirements and support	
Observation	Two-way video recording in class; observation protocol on TPD objectives, class structure and exploratory notes	Camtasia recording and in-person observation of online interactions; two-way video recording in class; observation protocol on TPD objectives, class structure and exploratory notes	Two-way video recording in class; observation protocol on TPD objectives, class structure and exploratory notes	
Reflection meetings	Reflection session on current practice		Reflection session on changes to practice	
Surveys	Pre-survey	Satisfaction survey	Post-survey	Follow-up survey

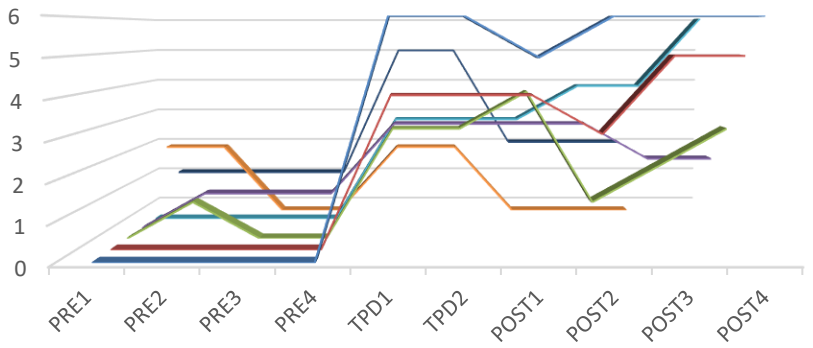
Recording was done two ways: 1) in a mobile ethnographic approach, teachers wore small camcorders around their necks, enabling the researcher to view the classroom from the teacher's perspective; 2) a video camera in a corner captured most of the classroom, including teacher and students. Eight to ten 90-minute classes were recorded for each of the seven teachers. The in-class observation was documented in observation protocols, including evaluation of the behavioral objectives of the course and grounded observations of teacher–student interactions and student engagement, as well as detailed descriptions of classroom activities (introduction, group work, etc.) and their duration. Additionally, reflection sessions were conducted with the teachers before and after the TPD intervention. In these sessions, inspired by the mind tape and retrospective interview methodologies (Kumar *et al.* 2007), participants watched video recordings of their teaching in groups of two or three and worked collaboratively to complete the learning content and exercises. Teachers' interactions with the platform, including preparation for classes, were recorded using Camtasia, a software program that can record the user's screen and mouse movements and a picture-in-picture setting. Here, the think-aloud approach was applied (Nielsen *et al.* 2002). Teachers responded to a pre-survey shortly before initiating the learning process, a satisfaction survey immediately following the conclusion of TPD, and a post-survey (identical to the pre-survey) approximately one month after completion. The post-survey was repeated 6–9 months after completion. The surveys included retrospective self-assessment questions related to each of the platform's behavioral objectives to illuminate the self-assessed use of the material before and after the TPD intervention.

4.2. Data Analysis

The analysis compared teachers before and after across schools, learning objectives, self-assessments (surveys) and observations. The observation protocols included rich in-class evaluations of the teaching on the TPD behavioral objectives, which, together with the video recordings, informed a 0–6 rating of teachers' performance on the behavioral objectives for each 90-minute class in the PRE-phase, TPD-phase and POST-phase. Using descriptive statistics, teachers' performance

curves could be compared; these curves are depicted in Figure 1. The teachers' names have been replaced by the letters A–G.

Figure 2. Teachers' performance (observation)

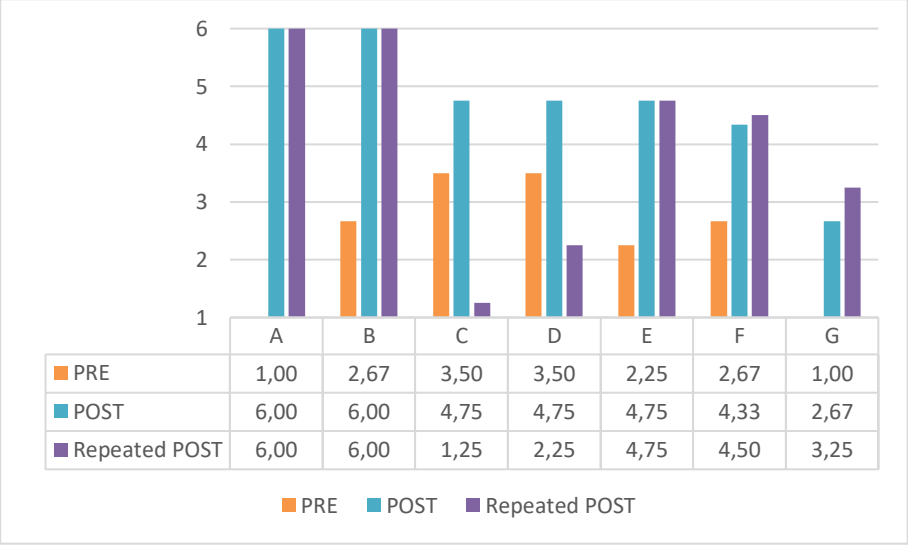


	PRE1	PRE2	PRE3	PRE4	TPD1	TPD2	POST1	POST2	POST3	POST4
A	0	0	0	0	6	6	5	6	6	6
B	0	0	0	0	4	4	4	3	5	5
C	0	1	0	0	3	3	4	1	2	3
D	0	1	1	1	3	3	3	3	2	2
E	0	0	0	0	3	3	3	4	4	6
F	2	2	0	0	2	2	0	0	0	
G	1	1	1	1	5	5	2	2	2	

In the chart in Figure 2, the rating scale is depicted along the y-axis. Along the x-axis, each of the in-class observation sessions is listed (PRE1-4, TPD1-2, POST1-4). There were no POST4 observation sessions for Teachers F and G. It should also be noted that Teachers C, D, and E only were observed during one session in the DURING-phase (DURING1), but the same rating has been inserted in the DURING2 field to avoid breaking the curve.

Observations prior to the intervention indicated that the participants had similar teaching approaches and structures. All teachers engaged in active learning pedagogy, asking students 46 questions on average during a typical 90-minute class. None of the teachers used inquiry-based methods to structure their teaching. Concurrently, in the PRE-phase in Figure 2, the general trend shows little to no performance on the objectives. During TPD, the teachers met the learning objectives to varying degrees. In the POST phase, following completion of the TPD, there were no teaching requirements, but the classroom observations continued. The variation in the curves in the POST-phase was surprising.

Figure 3. Teachers' performance (self-assessed)



	A	B	C	D	E	F	G
PRE	1,00	2,67	3,50	3,50	2,25	2,67	1,00
POST	6,00	6,00	4,75	4,75	4,75	4,33	2,67
Repeated POST	6,00	6,00	1,25	2,25	4,75	4,50	3,25

The observed performance on the learning objectives (Fig. 2) differs from the self-assessments of the teachers (Fig. 3) and indicates that either the teachers overrate their performance or the researcher underrates their performance when observed; Teacher A is the only one whose observation and self-assessment are identical. Nevertheless, comparing the PRE and POST observations ratings in Figure 2 with the self-assessments, the tendencies for each teacher are similar; the teachers rated high in the POST observation (Teachers A, B and E) have high self-assessment. With the

exception of Teacher F, the other teachers' ratings can also be recognized in the curves. The repeated POST seems to confirm the tendencies evident in the chart in Figure 2 better than the POST-survey, which is indicative of a sustainment of the tendencies at the point in time where the observations ended.

Looking back at Figure 2, the curves started expressing great variation following the intervention as teachers independently implemented the TPD content in their teaching. A classical satisfaction survey or learning outcome test conducted at completion of the intervention would not have reflected this variation, which brings into question such tools' appositeness in measuring TPD effectiveness.

It was at this point of variation that several teachers expressed frustration. The two teachers most overtly frustrated (Teachers A and D) showed very diverse performance curves and were thus selected for the further investigation of teacher frustration presented in this article. An in-depth analysis of the frustration of these two extreme teacher cases may help explain some of their differences as well as the general complexities of TPD initiated change. The analysis was an informed grounded analysis (Thornberg 2012) conducted on the qualitative data; it was coded line-by-line (primarily in vivo), conceptualized and categorized using NVivo software (as described in Charmaz 2012). This approach yielded cross-teacher perspectives on change and in-depth understanding of each of the teachers' developmental processes.

4.3. Results

The two cases are presented under the pseudonyms Christine Sørensen (Teacher A, Fig. 1) and Lillian Andersen (Teacher D, Fig. 1). At the time of observation in 2014, Christine was 33 years old, with three years of in-service teaching experience. She had taught science for two years and had not received any professional development in her time as a teacher. Lillian was 49 years old, with eight years teaching seniority in science, and had previously participated in several shorter professional development courses.

Figure 2 shows that Lillian performed on a few elements of the objectives in the PRE-phase (PRE1–4, Fig. 2), although the general picture shows little objective-specific performance for either teacher. During the TPD (TPD1–2, Fig. 2),

Christine performed fully on the learning objectives, indicating that she completely restructured her teaching in accordance with the new inquiry-based teaching. Lillian applied only part of a new questioning technique and a tool for gathering students' questions to plan the next year's curriculum. The follow-up surveys indicated that Christine sustained the change in her teaching, whereas Lillian was no longer teaching as per the course objectives, implying a further drop in her curve.

Lillian and Christine shared only a few commonalities as teachers, which may explain some of the variation in their performance during the TPD process. For instance, with regard to teaching styles, while Lillian was directive (measured by Danish standards) and apparently did not allow students to guess openly, Christine was more receptive of students' wishes and inputs. She additionally appeared somewhat insecure in her teaching. Their motivation and attitudes also differed; as a relatively new teacher, Christine craved support to improve her science teaching and voluntarily opted in on the TPD. Lillian, who was more experienced, apparently participated voluntarily as well but is likely to have felt pressured to join by her principal (with whom Lillian did not get along).

There is fairly consistent evidence that teacher growth is substantial within the first 3–5 years of service but diminishes substantially or stagnates thereafter (review in TNTP 2015). This tendency may help to explain Christine's high acceptance and performance of the behavioral objectives as compared with Lillian. It is also worth mentioning that Lillian was high in self-efficacy prior to the TPD, whereas Christine was low; this may also have affected their respective motivation and efforts to change: '[H]igh self-efficacy on PDI objectives prior to the intervention may undermine a sense of urgency to change, because the employee believes that she is already capable of and possibly already doing what is taught in the PDI' (Noesgaard 2016a). Another reason for Christine's higher performance on the objectives may be that the TPD was a clear priority for her school principal, creating a sense of urgency to act. Lillian's principal was also supportive of the TPD intervention, but their negative relationship may have made the TPD endorsement of the principal counterproductive to Lillian's efforts to change. The experiences of the two teachers will inform the discussion of teacher frustration that follows.

4.3.1. Definition and causes of teacher frustration

Frustration theory can help define teacher frustration and highlight its basic mechanisms. Frustration is understood as a response to 'nonreward in the presence of anticipated reward' (Amsel 1992, p 396). Adding a cognitive element to this stimulus-response approach, frustration involves a new recognition that one's surroundings do not correspond to one's expected context of action (Bateson 2000). Relatedly, the teachers experienced strong frustrations when their actions did not yield the anticipated results or reactions; for example, as part of a reflection exercise after a teaching session in which Lillian tried to change her questioning technique, she explained that '…I was in doubt about when to ask the questions I had prepared and when I did, it didn't work well.' Lillian was not satisfied with the flow in her teaching: 'It was awkward!' (Observation notes, online reflection exercise in groups, referring to TPD1, Fig. 2). Lillian reported that changing her teaching in accordance with the TPD behavioral objectives did not improve her teaching (nonreward) as promised (anticipated reward).

When interpreting the possible cause of the teachers' frustration, the theory of self-affirmation may assist a conceptual frame. The theory augments the conceptualization of teacher frustration by introducing considerations of the self. The premise of self-affirmation theory is that 'individuals have a fundamental need or motive to maintain a positive, global self-evaluation. When the self-concept is threatened, people experience psychological discomfort that they are motivated to reduce' (McQueen and Klein 2006, p. 289). Pioneered by Steele and Liu (1983), self-affirmation theory explains how the individual will seek to maintain or restore a perception of global integrity when something threatens his or her self-image. Any such threat can lead to defensive responses and resistance to change in order to protect one's self concept. This may include rationalization and self-justification, enabling the individual to resist threatening information even though that information might (in the present context) improve the quality of his or her teaching decisions (Cohen and Sherman 2014; Steele *et al.* 1993). In this regard, psychological discomfort is the equivalent of teacher

frustration, surfacing as a consequence of a threat to the teacher's personal style and beliefs, potentially impacting negatively on teaching decisions.

4.3.2. Consequences of teacher frustration

If a teacher perceives the TPD intervention as ineffective, failing to deliver promised teaching improvements, it is rational, when applying frustration theory, to avoid the goal of changing as per TPD objectives. It is rational, because the change is negatively conditioned with frustration (Amsel 1992); in the presence of the anticipated frustration, efforts to achieve the goal are extinguished. Though simplified, this means that once there is frustration in implementing TPD in the classroom (as was the case for Lillian), the teacher anticipates that the frustration will reoccur with further implementation attempts. As a result, the teacher may resolve the conflict by ceasing to apply the changes in the classroom in order to avoid frustration.

It is known that teachers need to see evidence of TPD effectiveness in their classroom before committing to new ways of teaching. According to Guskey, 'New practices are likely to be abandoned […], in the absence of any evidence of their positive effects (2002b, p. 387). The above definition in of teacher frustration (4.3.1) helps to explain the lack of sustainable change in classroom teaching; teachers become frustrated by the lack of evidence of TPD effectiveness in improving student learning (nonreward) and consequently abandon their attempts at implementation (goal avoidance). Lillian's case supports this account. Her use of TPD objectives declines in the POST-phase (Fig. 2), and in the follow-up survey, she responds that she is not applying any of the behavioral objectives in her teaching. In short, frustration is likely to have led her to abandon the proposed change.

Adding the self-affirmative perspective to the behavioral analysis of frustration theory can, additionally, contribute an explanation to teachers returning to status quo; when initial TPD-based change does not yield the expected results, adhering to current ways of teaching represents an opportunity to affirm one's self-concept; the lack of positive visible results in practice justifies seeking to end the initiated change, so restoring perceived self-integrity. Again, this further emphasizes the vulnerability of initiated change. Unlike Lillian, Christine expressed frustration

with her own teaching incompetence (internal weakness) because of her lack of experience and knowledge of how to teach science. She did not visibly respond as defensively as Lillian, which may explain why she was receptive to making profound changes to her teaching in line with the behavioral objectives of the TPD. Ironically, Christine's frustration surfaced in the classroom precisely because she tried to alter her teaching entirely and immediately, perhaps because she was not threatened by the proposed change but was instead actively looking for ways to improve her teaching.

4.3.3. Practical implications of teacher frustration

To reduce the likelihood of a return to the status quo because of frustration, it may be beneficial to manage expectations (anticipation of reward) about the immediate effects of the proposed change. A TPD intervention generally includes more than one attempt to convince teachers of its effectiveness by illustrating the benefits in terms of concrete examples of 'what's in it for me,' including positive scenarios and teacher testimonials, but rarely does the intervention prepare the teacher for the potentially frustrating task of changing behavior. If teachers understand that changing teaching habits will require profound concentration and reflection on activities that were previously routine, and if they expect a temporary period of incompetence while practicing new skills, they may be better equipped to manage frustration and seek support. Additionally, according to frustration theory, goal avoidance in the presence of anticipated frustration can be circumvented through instrumental counterconditioning (Amsel 1992)—that is, rewarding efforts toward the goal to avoid extinguishing an initiated change or to re-initiate it if already abandoned. Guskey (2002b, p. 387) noted that 'practices that are new and unfamiliar will be accepted and retained when they are perceived as increasing one's competence and development.' It follows that making teachers aware of even minor or short-term results and progress (turning non-reward into reward) may encourage them to proceed. For instance, Lillian might have increased her efforts if she was made aware that two of her students, who were normally inactive in her classes, had become more active even though the general activity level of the class had decreased.

5. Adding context with a situated perspective

Variation in the performance curves and the frustration occurred when teachers tried to situate what they had learned in their teaching contexts. A situated perspective on learning broadens the understanding of teacher learning as constituted in multiple situations (Borko 2004). From this perspective, learning is neither a matter of responses to certain stimuli (as in frustration theory) nor a matter of the humanistic 'self' (as in self-affirmation theory). Instead, learning is present and enabled in the relational specificity of contexts, making the notion of detaching from concrete experience problematic. Such theoretical underpinning to TPD calls into question the idea of the transfer of learning, along with the measurement of pre-defined learning objectives (as in Figs. 2, 3). Concurrently, the exploratory parts of the empirical study made it clear that the teachers did not transfer any part of the TPD directly into the teaching context of the classroom. Instead, the proposed change is transformed into something meaningful in the context. For this reason, teachers' implementation of TPD behavioral objectives is not primarily a matter of *whether or not* the teacher implements the TPD objectives or *to what extent* they do so. Rather, it is a matter of *how* learning processes situated in the classroom *form* TPD input to be effective in the specific classroom. The idea that TPD interventions convey objective knowledge is then abandoned, and TPD effectiveness is no longer a question of transferring as much of the exact content as possible toward pre-defined standardized objectives. Instead, effectiveness becomes a context-defined mix of current and new teaching that enhances student learning and engagement. This may or may not resemble the observer's understanding of the TPD objectives.

At face value, such situated learning processes appear to be flexible, positive mechanisms, optimizing the situated value of the TPD. Hence, the situated perspective supports the argument that teachers know best what is effective, as this so heavily depends on the specific teaching context. It follows that teachers should be left to situate TPD objectives meaningfully in line with the needs and abilities of their students and in accordance with their own teaching style. However, situated learning theory has been criticized as a harmonious analysis of cultural assimilation, with no

reference to the contradictions and tensions of the context (Haigh 2007). This critique is relevant here, as failure to scrutinize such tensions, of which frustration is a consequence, may vindicate teachers' preference for the status quo—for instance, as a consequence of a threat to self-concept (self-affirmation theory) or of negatively conditioned goal avoidance (frustration theory). At the same time, a situated perspective supports an alternative definition of teacher frustration as the inability to meaningfully situate (demand for) the TPD change in current classroom teaching.

5.1 The students

In the empirical study, teacher frustration occurs in the classroom as the teacher interacts with students and with the physical and cultural context. In TPD, we often forget how diverse the student's reactions to chance may be and how critical these counterpart reactions may be for TPD effectiveness. This includes random and seemingly unimportant elements in Christine and Lillian's classes, such as 'There's a new girl in the class' or 'A third of the class is dealing with birch-allergies' or 'We're on camera!' In the very vulnerable early stage of initiating change in teaching, such elements impact teachers' search for evidence of TPD effectiveness. From a situated perspective, the intervention is learned anew in the classroom and will look different in each teaching context, partly because of such 'unimportant' influences on its impact.

According to Ericson and Ellett (2002), a lack of success in teaching is too often assumed to mean either that the teaching was poor (that is, the teacher is a failure) or that the teacher was not trying in the first place. Several studies have explored the other side of the teaching equation: the students. For example, Lampert (2001) focused on the 'practice of studying' and Fenstermacher (1986) on 'studenting' as the parallel to teaching. Citing Fenstermacher, Ericson and Ellett (2002, p. 4) discussed how the classroom interactions of the students are as critical as those of the teacher:

> Students, obviously, are not raw materials awaiting only a teacher's skillful hands. They are an integral part of the learning process. […] In other words, we are speaking of an *interactive* causal process in

> which *either* poor teaching or poor 'studenting' is generally sufficient for a lack of student success.

Those words highlight the need to consider not only the teacher's learning process and frustration but also that of the students when designing and evaluating TPD.

When a teacher imposes change in classroom interactions to which students are not accustomed, those students may fail to react in the expected way, causing frustration for the teacher. Implementing teaching changes in accordance with the TPD does not naturally result in improved teaching or increase student engagement; like teachers, students can become frustrated, accepting, modifying or rejecting changes to the interaction. Discussing how students receive feedback, Hattie and Timperley (2007, p. 87) characterized students as anything but passive recipients:

> They (students) may choose to blur the goals, combining them with so many others that after performing, they can pick and choose those goals they attained and ignore the others. Alternatively, students can change the standard by setting less challenging goals, accepting performance far below their capabilities as satisfactory.

While the extent to which students *knowingly* manipulate goals is arguable, the above quote underlines that the teacher cannot predict students' responses to TPD-initiated change in the classroom, nor does the absence of a positive student response disprove the need for that change. When teachers change their methods of teaching, they change the rules of interaction. If students are not informed about, accustomed to or able to understand their teacher's new way of posing questions, they may become confused, frustrated and disappointed. Becoming a 'confused counterpart' to the changing teacher may be especially evident if a student had worked out how to perform well under the previous rules of interaction:

> In the introduction of today's teaching, Lillian is making an effort to pose productive questions in her teaching: She is adding 'What do you think?' to her questions, but the students are quiet (it still doesn't feel like it is all right for them to guess). After 30 minutes Lillian asks the students, 'Are you just completely blank today?!'

> A few students say 'Yes!' (Observation notes, in-class teaching, POST2, Fig. 2).

As her students reacted to the change in her teaching with inactivity, Lillian continued to be frustrated in the POST-phase. In contrast, Christine's frustration was linked to her students' contrary reactions—they became overly active:

> Christine is working on creating questions for investigation with the students (Theme: The body). The students pose questions that have nothing to do with her introduction about a bike ride. One student asks, 'Why do women have to give birth?' After a few minutes, Christine looks directly at me and says, 'This is not going to be good!' (Observation notes, in-class teaching, POST1, Fig. 2).

The research assistant (RA) who observed this class reported how Christine had prepared for the class and was very excited to try out her new knowledge. Nevertheless, the RA observed that the students did not do what Christine intended, and it appeared that they simply did not know what to do:

> It just did not work. It was a complete mismatch between her plan and the students. I was clearly extremely uncomfortable for her. It was painful to watch as she appeared to have no control of the class. She was all red on the neck and cheeks—she even appeared to break a sweat. She was clearly physically uncomfortable.

The RA also wrote down field notes of his conversation with Christine after the teaching:

> After the class, Christine and I talk about the teaching. She is clearly frustrated about the way in which the day turned out. She very clearly expresses that she believes the cause is that she made it (the teaching) way too open way too early for the students, because they are not used to working in this way. (Observation notes, in-class teaching, POST1, Fig. 2).

Students are as critical to successful TPD implementation as teachers. When teaching changes, students must relearn how to be competent as students (a new kind of 'studenting'). The situated perspective underlines how realizing potential change

depends crucially on the specificities of in situ teaching—including students, who must adapt to the changes imposed by their teacher.

5.2 Practical implications of a situated modification

When the interplay of factors leading to frustration is situational, it becomes unpredictable and therefore unplannable. Consequently, even a strong learning design, favorable individual characteristics and attitudes and a supportive work environment can only support change; they cannot ensure it. Transformation of TPD objectives into contextually meaningful change requires an individualized process of pressure and support (Guskey 2002b). Temporally, this scaffolding differs from pre-planned follow-up on TPI interventions because it can capture individual teachers before they resolve their frustration by abandoning the initiated change. Christine remained frustrated; two days after the class (POST1, Fig. 2), she called the RA, who happened to be an experienced teacher, project manager and coach. They spoke for about 30 minutes. 'She is very frustrated about the experience last Tuesday and she said, "I would rather you don't come," referring to our appointment to record her teaching next week.' (Included in observation notes, in-class teaching, POST1, Fig. 2). The RA asked about her perception of the last class, assuring Christine that he was not in her class to judge her but to understand whether the TPD was of help to her. In other words, if the teaching is not effective, the TPD is to blame. In addition, he emphasized that only the researchers would see the recordings, and this seemed to put her at ease. Although trying not to push too hard, he thought it would be a shame to stop the observation at this juncture—not only for the sake of the research but because he had noticed that Christine had already undergone positive change and gained confidence in her teaching. Christine decided to continue.

Here, Christine received timely individualized support, which entailed lowering her ambitions for change to a level the students could manage and being assured that her self-integrity was not at stake. Lillian, on the other hand, may have benefited from supportive pressure to apply more of the TPD change so that it would make better sense to the students and help her to see short-term results of her efforts.

Clearly, then, managing situated frustration calls for timely, situated and individualized support.

6. Teacher frustration at the tipping point of change

6.1 Potential of teacher frustration

Teacher frustration was initially defined as a consequence of the teacher's actions failing to yield the anticipated reactions and results. We have arrived at a situated extension in which teacher frustration is defined as a consequence of an inability to situate the proposed change meaningfully in the classroom. A common denominator of the two definitions is that frustration arises when change becomes unexpectedly challenging, and the likely consequence is adherence to the status quo or abandonment of initiated change.

Difficult challenges are also an opportunity for growth. A number of theories of learning (including self-affirmation theory) actualize both the hardship and the potential for substantial growth based on a higher order of learning, such as expansive learning (Engeström and Sannino 2010), learning III (Bateson 2000), accommodation (Piaget cited in Sziraki 1978) and transformative learning (Mezirow 1997). While epistemologically diverse, these theories actualize a process in which habits and beliefs can be challenged and changed—when new knowledge is not an extension of what we know but changes what we knew. In line with the present findings, these theories underline how accommodating habits and beliefs to new knowledge can be a very frustrating process, one that is likely to result in the abandonment of change.

6.2 Regressive versus transformative frustration

Transformative learning theories suggest that frustrating situations, entailing contradictions and tensions, present opportunities for substantial growth. In this sense, teacher frustration can be a positive sign that the teacher is challenging previous ways of teaching. This can be seen as a critical first step to transformative change if the frustration is appropriately resolved. Realization of this potential can be conceptualized as 'transformative frustration.' Similar to the concept of productive frustration coined by Knud Illeris (2006), frustration is, thus, necessary for a reflective

learning process to occur (Illeris 2006).

At the same time, teacher frustration indicates that the proposed change is not currently helping the teacher or the students in the classroom. The counterpart to transformative frustration is 'regressive frustration,' leading to the abandonment of initiated learning and change and largely returning to previous ways of teaching.

It is tempting to propose only a terminology of regressive/progressive frustration. The concept 'progressive frustration' is, however, primarily useful to reflect the frustration arising with challenging TPD *elements*, which are manageable in time and scope for the teacher, and may be solved without either completely transforming or preserving teaching. Fortunately, not all challenges to our self-image threaten self-concept: '[T]he goal of the system is maintenance of an overall image of self-integrity and not necessarily the dismissal of each image threat that comes along' (Steele *et al.* 1993, p. 885). Consequently, progressive frustration is the in-between of transformative and regressive frustration, resulting in stepwise changes in teaching, while transformative and regressive frustration conceptualizes the consequential extremities at the tipping point to change.

Christine's and Lillian's strong responses and unambiguous consequences in resolving inherent conflicts thus represent transformative frustration and regressive frustration respectively; Lillian was the participant who was least satisfied with the TPD process (NPS: 5); her frustration was largely resolved by returning to the status quo. She did get ideas for field trips and used a TPD tool to engage students in planning next year's curriculum, but the unmanaged frustration also negatively impacted her teaching, in which she became more insecure and agitated. This regressive frustration raises the question of whether it might have been better for Lillian and her students had she never participated in the first place. In contrast, Christine was the teacher most satisfied with the process (NPS: 10), and through timely and individualized support, her frustration became transformative. The RA described Christine's class after the phone call as follows:

> This class is great! It is structured and inquiry-based with almost 100% engagement from the students; they all know what to do and

> the kids even get to take their pulse after a run in the schoolyard (Theme: the body). It's some of the best teaching I have seen. (Observation notes, in-class teaching, POST2, Fig. 2)

He noted how happy and excited Christine was after the class. As a speculative observation, Christine's frustration may have proved regressive without individual support, especially as the course was the last before summer and Christine risked going on vacation in the wake of another failed class. The RA visited her after the summer and found not only that Christine had continued her teaching transformation but that her 'shoulders had come down.' Christine became an ambassador for the TPD intervention, and by mid-2015, she had voluntarily supported all 10 science teachers at her school in completing the intervention.

7. Concluding remarks

The process of teacher change is complex, situational and multidimensional. Generally, the process of designing TPD interventions is oversimplified, trusting in the transfer of knowledge to initiate and sustain change. The present paper illustrates some of the complexities of TPD change by unpacking teacher frustration in theory and practice. It becomes clear that frustration is a potential tipping point, leading either to substantial growth (transformative frustration) or to persistence in or a return to the status quo (regressive frustration). Much depends on the timely identification of frustrated teachers and the provision of individual support in their teaching contexts.

Context-dependent knowledge and experience are at the core of expert activity, as experts operate on the basis of intimate knowledge of a large number of cases in their area (Flyvbjerg 2006). It seems clear that TPD would benefit from some well-chosen context-dependent teacher cases to complement the context-independent knowledge and rules of the field. Rich cases like those of Christine and Lillian can help us to embrace the exceptions, extremities and inconsistencies of lived reality and, in so doing, harvest the potential of TPD and its potentially frustrated participants.

Acknowledgments

This work has been supported by the KATA Foundation, Denmark and Innovation Fund Denmark [grant number 13-135439, 1355-00007B]. I am grateful to Professor Rikke Ørngreen for her insightful comments on a draft of this paper.

References

References can be found in the dissertation's literature list.

9.3. KEY CONTRIBUTION

Chapter 9 has unfolded some of the complexities and contextualities of oPD effectiveness in order to understand the conditions under which oPDIs can be effective in advancing work practices (research question 2).

Section 9.1 showed that there was no direct transfer of learning to practice in RS2. Instead, the practitioners engaged in complex strategic negotiations of the effectiveness of KpN1, which led to KpN1 content and objectives being recontextualized by means of modifying KpN and their practices in a way that seemed appropriate and meaningful for the practitioners. The comparison of strategies with the extent to which the teachers performed on the KpN objectives (Chapter 8) showed that the teachers who engaged in strategies of resistance, thus primarily modifying KpN, performed to a lesser extent on the learning objectives than the teachers who used the strategies of acceptance. The reasons for resistance may include a number of contextual factors, such as a non-supportive school culture and a lack of motivation due to negatively perceived school reforms, in addition to the factors listed in Article A (Section 2.1). This section contributes the finding that ensuring that oPD adds direct value to practitioners' already existing tasks instead of adding work could be a way to increase perception of oPD effectiveness even in a climate of resistance. In addition, while collaboration in such a climate may negatively influence change, evidence was found that perceived oPDI effectiveness in practice may overrule a collaborative climate of resistance.

Section 9.2 added yet another layer of complexity by pointing to the unpredictable and unplannable aspects of oPDI effectiveness. The oPDI is not the general initiator of sustainable change in practices; sustainable change is initiated by the results the practitioner perceives, or their absence in situ. By investigating teacher frustration, Article C defined frustration as the inability to meaningfully situate (demand for) TPD change in current practice. It underlined the great learning potential of frustration and coined transformative and regressive frustration as "the consequential extremities at the tipping point to change." The absence of visible results due to a combination of confused counterparts and implementation dip in performance may become a roadblock for advances to practices as defined from both the teachers' and initiator's perspectives.

9.3.1. IMPLICATIONS FOR DESIGN

The theory construction of strategies suggests a frame in which to answer which narratives and strategies practitioners may be constructing to avoid and embrace changes in their practices. This can, in turn, illuminate some of the complexity and dynamics in advancing practices through oPDIs. Specifically, the theory of strategies can be used as a pragmatic instrument for anticipating a multitude of participants' responses and considering if any contextual challenges can be mediated before and in

situ to modify strategies of resistance. Strategies indicate that teachers' narratives in the interaction with oPD interventions may be indicative of their efforts to change; thus, some mediation may be possible. On the other hand, unpredictable interaction in the classroom seems to have a final say in the extent to which the intervention is defined as effective and change is sustained. This further underlines the need for timely, individualized, and situated support for the transformative learning potential of frustration to be achieved.

This chapter has identified and discussed some of the conditions under which oPDIs can be effective in advancing work practices. This includes "timely" support, which means that PD support must literally be present *in* the (potentially frustrating) situations in which the practitioner finds himself or herself; this includes a mechanism for showing the practitioner even minor or short-term results in real-time. In addition, Chapter 9 underlines the necessity for oPDIs to assist practitioners with existing tasks instead of adding extra work to their already busy work lives.

CHAPTER 10. RS3: SCAFFOLDING THROUGH MOBILE PROBES

This chapter consists of Article D, which presents early findings from RS3. The study entailed the use of mobile probes to gather data on teachers' intervention-based reflections and change while in the context of their daily work life. Mobile probes are of interest to this dissertation's third research question: How can online professional development interventions be effective in advancing work practices? This is because mobile probes as a research method in RS3 became a way to scaffold the practitioners in their efforts to advance teaching by means of KpN. The "online resource" referred to in Article D is KpN. KpN had undergone the first iterations before RS3; thus, the specific online resource investigated in RS3 is KpN2 (as illustrated in Figure 4, Section 4.2).

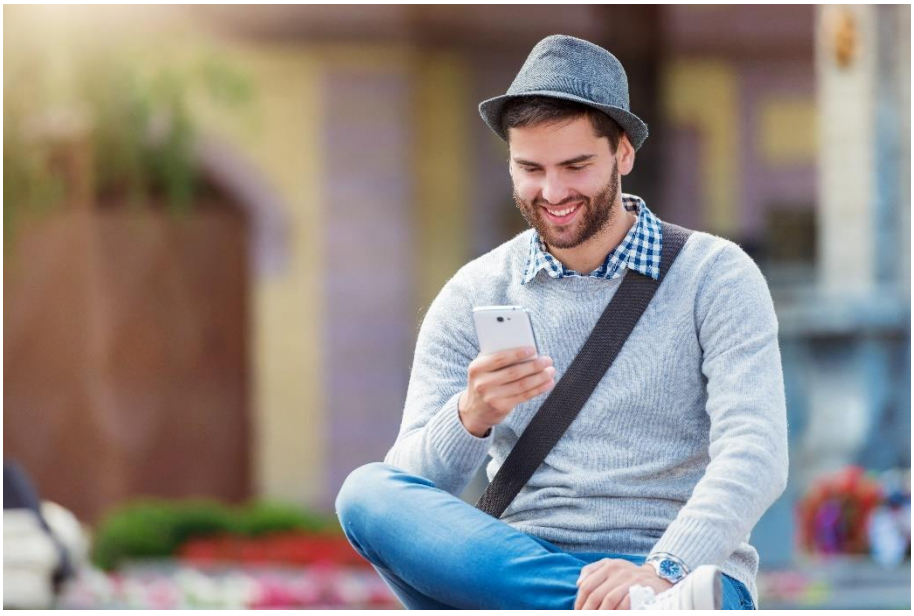
10.1. ARTICLE D

Mobile Probes:
A Scaffold for Local Learning with Online Resources?

Authors: Rikke Ørngreen, Anne Jørgensen & Signe Schack Noesgaard

Prof. Rikke Ørngreen was lead author. Her and Anna Jørgensen conducted RS3. I contributed in the structuring and writing of the article, in addition to contributing the findings form RS1 and RS2.

Published in Proceedings of the 5th International Conference on Designs for Learning. Aalborg Universitetsforlag, 2016. p. 283-299.



MOBILE PROBES: A SCAFFOLD FOR LOCAL LEARNING WITH ONLINE RESOURCES?

By RIKKE ØRNGREEN[1]; ANNA NEUSTRUP JØRGENSEN[1] & SIGNE SCHACK NOESGAARD[1&2]

[1]Aalborg University, Copenhagen, Denmark
[2]Kata Foundation, Sønderborg, Denmark

A project investigating the effectiveness of a collection of online resources for teachers' professional development used mobile probes as a data collection method. Teachers received questions and tasks on their mobile in a dialogic manner while in their everyday context as opposed to in an interview. This method provided valuable insight into the contextual use, i.e. how did the online resource transfer to the work practice. However, the research team also found that mobile probes may provide the scaffolding necessary for individual and peer learning at a very local (intra-school) community level. This paper is an initial investigation of how the mobile probes process proved to engage teachers in their efforts to improve teaching. It also highlights some of the barriers emerging when applying mobile probes as a scaffold for learning.

Keywords: mobile probes, learning scaffold, online open learning, distributed learning environments, professional development

INTRODUCTION

This paper reports on the mobile probes phase of a large empirical project with science teachers in Danish elementary schools. This project designs and implements a collection of online multimedia materials that teachers can work with and apply to their teaching. In this paper, this collection of multimedia materials is referred to as the Online Resource (OR). The research is a design-based research (DBR) project (Amiel & Reeves, 2008) which commenced in 2013. DBR is an intervention research approach, characterized by iterative cycles of testing and refinement of solutions in practice and in collaboration with practitioners. DBR tries to simultaneously understand and contribute to the improvement of a specific educational practice (Amiel & Reeves, 2008). This paper presents findings from a phase which took place approximately two years into the larger project. The researchers discovered that a digital mobile data collection method, *mobile probes*, provided an opportunity for scaffolding learning-in-practice process at the individual and peer level.

The area of open online learning has grown in recent years in higher education and continuous learning. *Massive open online courses (MOOC)* are a rapidly growing trend in eLearning. There are two most commonly known types: xMOOC often have

standardised structure (video tutorials, readings and often computer graded assignments), where the instructor is viewed as the expert and the learner as a knowledge consumer. cMOOCs have an open structure and see knowledge as a networked state, where learners' participate in the collaborative process of sharing knowledge that others can connect to and with (Siemens 2013).

Few professional development activities for teachers are defined as MOOCs and further research on their effectiveness is needed (Jobe et al. 2014). The OR can best be described in terms of the quasi-MOOC format which does not provide the social interaction of cMOOCs or the automated grading and tutorial-driven format of xMOOCs. Quasi-MOOCs are loosely linked asynchronous learning resources that are not packaged as a course (Siemens, 2013). This OR likewise does not provide ready-made teaching plans and other activities to use as is. Rather, the focus is on the pedagogical and process level of inquiry-based teaching. On the other hand, it is also not an open space for sharing, as the OR in itself is not a Web 2.0 resource.

When dealing with large-scale professional development in geographically distributed environments, changes to professional practices often require the learners to partake in activities isolated from their workplaces. Referring to renowned teacher professional development researchers such as Borko, Elmore and Little, Schlager and Fusco discuss the argument: 'that teacher professional development is more than a series of training workshops, institutes, meetings, and in-service days. It is a process of learning how to put knowledge into practice through engagement in practice within a community of practitioners' (Schlager & Fusco, 2003, p. 205). They illustrate how a large body of studies on technology-driven learning relies on the notion that online learning can provide such a community of practice. However, they draw attention to the fact that many of the implemented online communities are isolated from the existing local communities of practice at the workplace, and further argue that there is great potential if the Internet is used to support these local communities (Schlager & Fusco, 2003).

The research scope and questions for this paper were not formulated prior to the commencement of the research project, but instead emerged during the research process as follows:

- What can be learned from mobile probes studies in the context of eLearning and professional development?
- How do the participants experience and change due to the mobile probes process?
- What signs are there that the mobile probes scaffold learning?

MOBILE PROBES

The term ‘mobile probes’ refers to mobile approaches used to collect digital data in various situations from and/or with participants, e.g. when investigating traffic situations or for gaining information from potential customers. In human–computer interaction (HCI), probes are often inspired by the cultural probe method, which is a very explorative and user-participative approach (e.g. Gaver & Penningtong, 2004). The cultural probes method involves activities where the researcher hands out or mails packages containing, for example, postcards or disposable cameras to the participants. The packages include largely open-ended questions and tasks for the participant to answer and return. Hence, the cultural probe method provides user-generated data, and the content of this data cannot be predicted beforehand. The data collecting process is seen as preceding the design phase and contributes to the qualitative knowledge base about users (as, e.g. presented in Gaver & Penningtong, 2004).

Rikke Ørngreen developed in 2013 a type of mobile probes approach, which was inspired by the cultural probes method, and by qualitative interviews. It was developed as the means to obtain insights about work situations and discover new (not yet identified) contextual factors when designing for online learning and knowledge sharing. This approach uses SMS/text messages with questions or tasks in a dialogical manner (Duvaa et al., 2013).This approach proved valuable in obtaining knowledge about users and their work with tasks, particularly when these users are geographically distributed and work asynchronous.

Duvaa et al. (2013) argue that though semi-structured interviews (as in Kvale, 1997) can aid in generating rich descriptions of the context, they only address issues that the researcher is able to address. Cultural probes add an element of uncertainty (Gaver & Penningtong, 2004), which provides an opportunity to uncover issues that were unknown to the researcher, but which could be important for the design. Similarly, the mobile probes method makes it possible for the researcher to ask questions by SMS about the user’s daily tasks and reflections on these tasks while they are still in the context of their daily work life. These unknown issues may not surface in an interview, as the users may not even be aware of their importance. By using the mobile probes, the researcher is able to ask about here-and-now issues (e.g. what are you doing/seeing/discussing right now?), and the user may also receive a task to perform in practice. These questions and tasks then unfold in a dialog with the user. Inspired by Darsø and Polainy, this is called ‘uncovering non-knowledge’: ‘Non-knowledge is the knowledge that depends on context, social relations and artifacts in order to become understood or recognized as significant and to be codified’ (Duvaa et al., 2013, p. 163).

The mobile probes developed by Duvaa et al. (2013) have a longer timespan than cultural probes or semi-structured interviews. The participant would typically receive three messages with questions or small tasks a day for one week / five work days. The

authors found the method successful in that it generated new insights, also there was a very high response rate to the questions. The interpretation by the researchers in the study was that the dialogical nature of this type of mobile probes (unlike cultural probes) would support the 'unravelling' of complex relations and identify key issues for the design process. However, even though the dialogical approach seemed to work, the researchers in the study concluded that it was difficult to engage users to give in-depth explanations, which seem easier in synchronous dialogs (whether online or face-to-face) (see Duvaa et al., 2013). In a similar study, an SMS probe was used, and the study also highlights the 'on-the-spot' answers of the method: 'The context you're in when you get the question will influence what you answer or how you do your assignment' (Jönsson et al., 2002, p. 19).

THE PROJECT FRAME

The OR is targeted at science teachers (primarily K1–6) and was developed by the Kata Foundation. The foundation partners with various stakeholders and research allies, including Aalborg University in this case. Figure 1 and 2 show screenshots from the OR, which gives an impression of the kind of interface the teachers are navigating in.

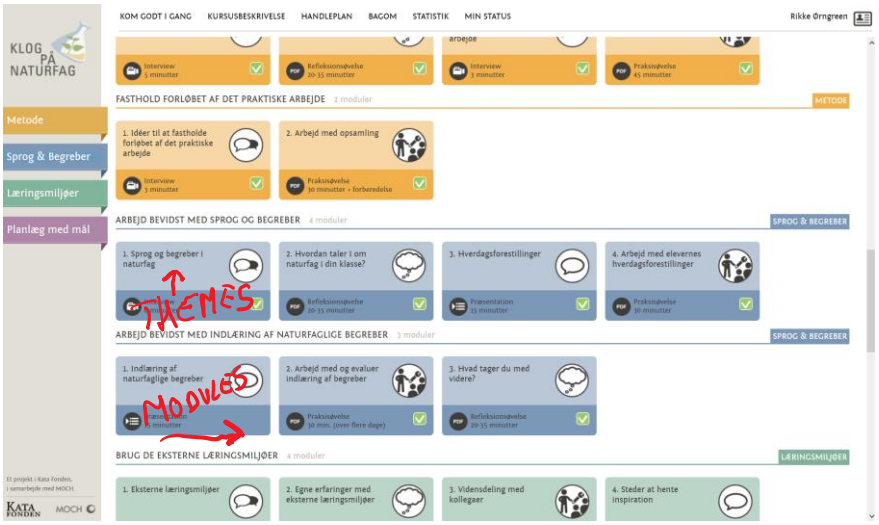


Figure 1.;A screenshot of the front page of the OR

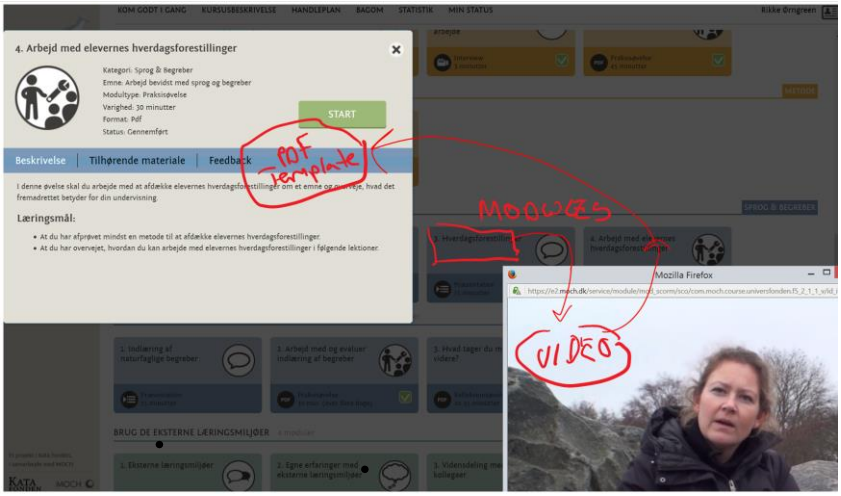


Figure 2.; A screenshot from the content pages of a module

Figure 3 depicts a possible pathway of how users are intended to work with the solution: The learning material is structured into modules that can be completed in any sequence, though a specific sequence is suggested for each module.

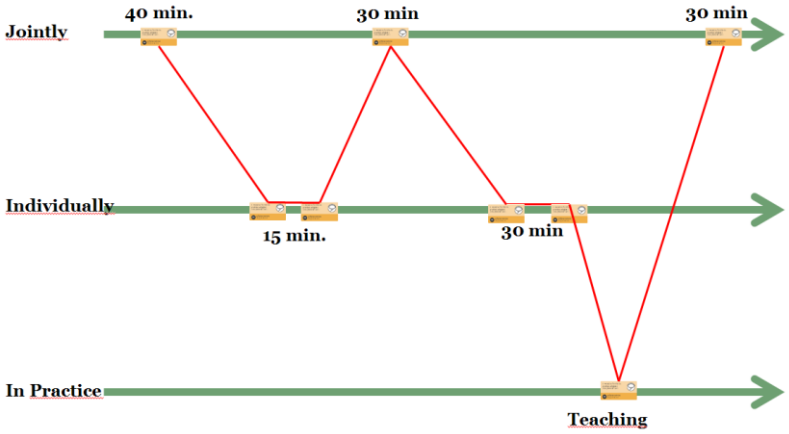


Figure 3: Suggested sequence from the module: ‘work practically with students’ (by project manager Jesper Ingerslev).

A timewise linear view of the DBR-based iterative process is depicted in figure 4. The development of the first version of the online resource (OR1) took place during the first year of the project in 2013. Simultaneously, the researchers established knowledge about science teachers' current practices through explorative field studies at two schools (RS1, as reported in Noesgaard, 2014). Once the first version was ready to test (OR1), a number of qualitative empirical studies were carried out during 2014 involving seven teachers at three Danish elementary schools (RS2, as reported in Noesgaard & Ørngreen, 2015).

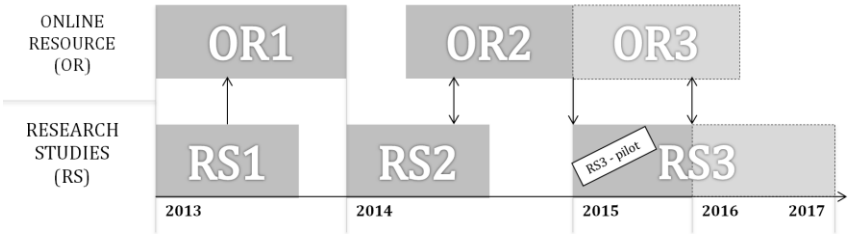


Figure 4: An overview of the interplay between research and design

Though the OR suggests that the teachers complete the modules in a sequential order, the 2014 RS2 indicated that teachers could not always be expected to work through the material as suggested. Even when the researchers were present, some teachers would skip through parts of the material and did not explicitly talk to each other about their current practices as requested in the exercises. However, three of the teachers noticeably changed their teaching in the process; nevertheless, most teachers used strategies to show that applying the material in their teaching was not necessary (Noesgaard & Ørngreen, 2015). In 2014, more modules were developed (OR2), and in the late spring/summer of 2015, the OR was made available for all K1–12 teachers in Denmark via an online login system governed by the state called uni-login. At the same time, preparations for a large-scale longitudinal empirical data collection process began (RS3).

For the research studies in 2015–2016 (RS3), a series of digital and remotely qualitative and quantitative research activities are planned. For example, a back-end statistical module provides information about which modules a certain uni-login has used. Similarly, a pre- and post-survey has been developed. The RS3 pilot took place in June 2015. The mobile probes were conducted at one school with two teachers. The pre- and post-surveys were given to two schools, with a total of five teachers completing the survey. Focus group interviews were held after both surveys and after

the mobile probes process with all five teachers. Despite a small cohort, it was possible to detect the relevance of the mobile probes as a scaffold because this relatively new mobile probes approach had already been used in three other projects as an empirical data collection method. The case of mobile probes as a learning scaffold can be viewed as an exemplary single case, which can inform science (Flyvbjerg, 2006) and indicate areas of further research. While stating that scaffolding and facilitating a learning process is vital to online distributed education may seem obvious and perhaps even naïve, the elements in this mobile probes approach were different from other facilitating processes that the researchers had previously seen in eLearning approaches.

MOBILE PROBES IN PILOT RS3

The RS1 investigated the current practices of science teachers and found that when designing for learning transfer, extra attention to the learners' work environment (context) is necessary (Noesgaard, 2014). Mobile probes were thus chosen because they provide an opportunity to follow people, who work at multiple locations and at different hours of the day. In addition, there are situations that are perhaps best 'seen' when the researcher is not present due to the private nature of a classroom setting. Of course, this is also a cost-effective approach compared to being physically present, which requires more man-hours and travel funds. Furthermore, it is an explicit choice to focus on the teachers' change process and inner thoughts (motivation, frustration etc.).

The RS2, where participants used the OR1, found that the teachers are able to self-report on learning effectiveness that involves parameters of satisfaction and transfer to practice - a finding which was in alignment with other studies in the literature (see Noesgaard & Ørngreen, 2015). The mobile probes could thus act as a self-reporting process.

As it emerged, the process showed that the mobile probes may not only act as self-reporting, but also as an act of scaffolding. Scaffolding can be defined as a process where the learner receives just-in-time support to solve problems or achieve learning goals, which this person without support had not been able to solve / reach (Belland 2014, Holton & Clarke, 2006). In education, scaffolding is usually used to refer to how teachers support their students. Holton and Clarke (2006) noted that not everything a teacher does can be viewed as scaffolding and that the following two components need to be present in order to count as scaffolding: to support the immediate construction of knowledge and to support the basis for independent learning in the future. Self-scaffolding and metacognition is considered an important component of problem solving and learning processes. Metacognition can be defined as 'the awareness that individuals have of their own thinking; their evaluation of that thinking; and their regulation of that thinking' (Holton & Clarke, 2006, p. 133, with reference to Wilson and Clarke).

The pilot began with (texting) a series of practical questions concerning which days the teacher teaches science topics, with which classes and if and how much they had already looked into the material online. This provided a framework for which new questions to text and when to text them (during the 2-week period). Prior to the commencement of the process, an array of themes (questions and tasks) had been identified as possible starting points for the dialogs. The intention with the pilot was to see if the themes and the process were meaningful to work with. The process included the perspective that the following question would depend on the answers received (as in a semi-structured interview, Kvale, 1997). This means that the researchers interpret the material when it is received and act upon it immediately. As such, analysis and interpretation of data was an ongoing process - in accordance with the DBR-thinking of the project.

The example in Figure 5 shows the teacher's reflections prior to her teaching. The correspondence shows that she does not normally micro plan a session in this way, and that she is considering if she will be more or less confined in her actions. While it is not possible to conclude that she would not have the same reflections without the probe, the question makes this issue explicit at this point.

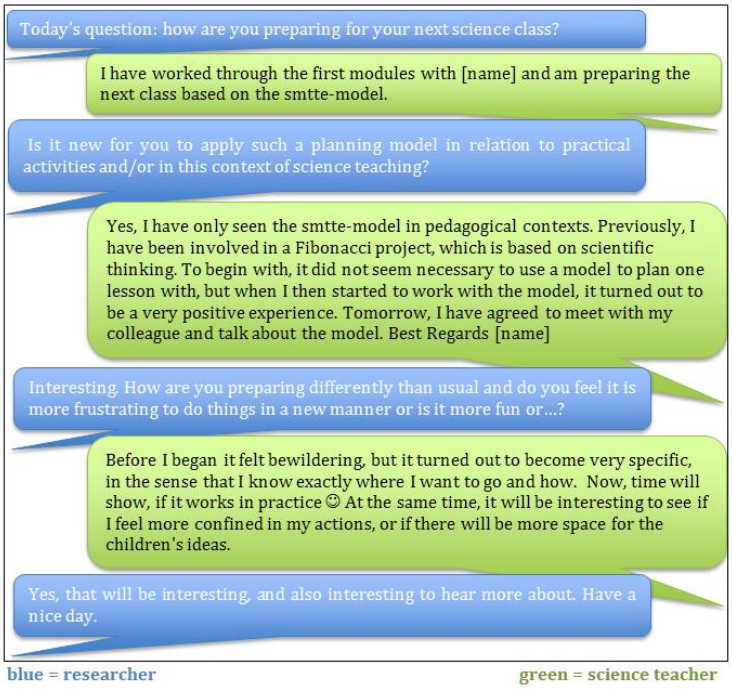


Figure 5: Participant on choice of module and micro planning (translated from Danish)

The length of the received messages ranges from a few words up to 200 words. An example of a lengthier answer is shown below in Figure 6, where the same teacher reflects in her preparation after the teaching. Two interesting matters should be noted from this example. First, by means of a relatively simple text message, the teachers reflect on and relate to how the material connects to their own practice, which in turn gives the research team meaningful knowledge about the context. When comparing the answers from before the teaching (Figure 5) with after the teaching (Figure 6), this teacher evaluates her steps and changes her mind regarding whether the model was useful as a planning tool for a single lesson. Second, this is an example of what was seen in both the mobile probes as well as the focus group interviews in the pilot: The teachers tend to over-plan, which leads to frustration. Many of the teachers plan with too much content and others plan with too many activities that they are not able to fit in the sessions.

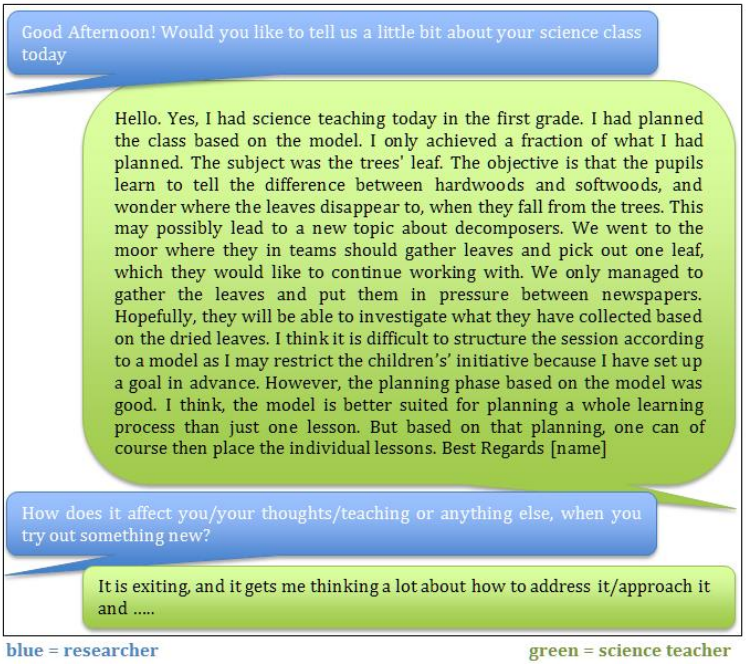


Figure 6: Participant on how the chosen module then worked in class (translated from Danish)

Figure 7 provides an example of the richness of the material received from the participants. In this particular situation, the 'wise word wall' [DK: Klog Ord Væg] situation from the dialog above. These pictures aid in understanding the context and the situation that took place. However, the act of taking the pictures and describing

what they represent also requires an evaluative and reflective stance from the teachers, forcing them to see their own decisions from an 'outside' position.

Figure 7. Contextual material returned by a participant
(faces and names scratched out by researchers)

Though this is not a quantitative analysis, an overview of the number of messages to/from the two teachers in the pilot RS3 is seen as meaningful, as it shows that this method seems to motivate to a dialog. 58 text messages, 32 questions, and 3 bigger tasks were sent from the researchers to the participants, and 40 text messages, 29 directly answered questions and 1 big task were returned from the participants - app.150 SMS in total. The response rate for the questions was 91%.

DISCUSSION

As professional development often occurs in real-world settings that are complex and include many intervening variables, causal interference is not possible. Furthermore, many schools are involved in several reform programs at the same time, which means that, ''isolating the effects of a single program or activity under such conditions is usually impossible" (Guskey, 2002a, p. 50). Nevertheless, Guskey often stresses that professional development initiatives should seek to focus on the relationship between professional development activities and the signs of improved learning among the students. This project focuses on signs of transfer of the OR to practice through teachers' self-evaluation. However, it has thus far proven to be difficult to get teachers to carry out tasks that are directed at getting more knowledge from their students. For example, a teacher was asked to interview her pupils about their experiences during the break immediately after the lesson. She was then supposed to record herself as she reflects aloud afterwards and send this recording to the research team. She misunderstood this task a little and instead recorded the short interview with her pupils. From the video, it is clear that she did not manage to get the children to evaluate or to give their opinions; rather, they gave a summary of activities in the lesson. Though not the exact task that was asked for, this dialog provided her with feedback regarding whether the children understood the lesson. The recording also shows that the children were very engaged, which is a sign of motivation. It cannot be concluded

that the teacher learned from this and thought about what to change/keep, as she did not offer any specific reflection in this regard. However, it can be argued that the mobile probes questions and tasks provide a space for doing so.

The professional development initiative with the OR3 is voluntary and thus the time and energy invested by the teachers is their own choice. Teachers in Denmark have a culture of working relatively autonomously with a lot of pedagogical freedom. Participants in this pilot are clearly collaborating (they refer to each other and to meetings in the mobile probes and post-interview). This is also seen in some of the newer mobile probes, which were initiated in January 2016 (RS3). However, since participation is voluntary, the research team now finds that getting teachers to begin the mobile process is quite difficult. Many teachers sign up, but fewer actually begin answering the first questions. This is the same dilemma that many MOOC providers face (Siemens, 2013).

These issues may be reinforced when it comes to quasi-MOOC solutions that rely on collaborative learning at local levels. In a report on open educational resources, a chapter on teachers' professional development concludes that there is a need to change the community culture around sharing: 'This is because teachers and instructors often show a reluctance to share or collaborate in open networks.' (OECD 2015, p. 48).

From the pre- and post-surveys in this project [RS3], it is evident that very few teachers collaborate with other teachers on planning, conducting and evaluating specific teaching. The discussions with teachers revealed that when they collaborate it is on a more practical daily administrative level and then primarily across subject/curricular boundaries, because teacher teams are formed around a grade-year or in subject matter teams which discuss themes of interest not a specific session. This reinforces that initiatives that ensure a sharing culture may need to be scaffolded from outside in order to change the practices and current work culture in small steps.

Follow-up activities are important to support sustainable large-scale change, e.g. an analysis of approximately 1300 studies confirmed the vital importance of follow-up (Guskey & Yoon, 2009). As previously mentioned, the intention of this project became to create an environment that supports and strengthens existing local communities, rather than just creating online communities (similar to the arguments of Schlager & Fusco, 2003). The mobile probes approach can provide such a space for local facilitation at the individual and peer level by providing just-in-time support to solve problems or ask direct questions that prompt evaluation and reflection.

In this light, mobile probes may be viewed as a heuristic scaffolding (Holton & Clarke, 2006), which encompasses open and generic questions (e.g. What are you doing? Why are you doing it? How does it help you?) that prompt metacognitive thinking, and as opposed to a conceptual scaffold, which is related to domain knowledge. The researchers' (in the analysis of the empirical material) and the participants' (in their

verbal reflection on the process in the focus group interview) experience that the mobile probes pilot had a positive influence on self-awareness and requires self-assessment (self-evaluation); however, signs of sustainable self-regulation have not yet been documented.

Teachers in general, as in many other professions, are reflective about their own everyday practice. The experience in this project, however, is that there is a difference between the reflections that involve thinking by oneself and those that are explicitly recorded (written or spoken) with an audience in mind. There is also a difference in reflecting on everyday descriptions or on a specific incident that is experienced as critical/profound. One of the participants compared the approach to 'having a weight watcher in your pocket' (from the post focus group). When one signs up for the Weight Watchers program, even though it is voluntary, one needs a gentle push once in a while to eat a carrot rather than the chocolate bar. Similarly, the mobile probes, though voluntary, can serve a disciplinary function.

Although too much frustration is not constructive for learning, reflective learning processes often have an element of productive frustration (Illeris, 2006). The teachers in the pilot showed signs of productive frustration. However, in the future use of mobile probes in this project (RS3), it is suggested that further investigations are conducted to examine what factors result in excessive frustration, at what moment do teachers 'give up' and whether there are circumstances where over-frustration can be turned into productive frustration.

For many years, the relationship between attitude and behaviour has been discussed, and there is evidence that changes in behaviour are not always linked to changed attitudes and beliefs (Ajzen & Fishbein, 1977). The mobile probes participants showed signs of transfer from the OR to practice and also provided productive insight into the difficulties they experienced. However, the data lacks sufficient depth and was not derived from a long-enough period of time to determine if this is a sign of sustainable change in attitude/beliefs. Also, the study is not a controlled experiment that can point to the correlating factors between attitude/belief and behaviour. Nonetheless, it is an example of people volunteering to being probed to act and then actually doing so, which means they start experimenting, without necessarily changing their whole setup and their entire mind-set. This may allow them to stay at a minimum frustration level, where the changes are incremental and manageable. These factors need more investigation.

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Changes take time, and the researchers in this study found that there is a need to utilise mobile probes of a longer duration than those used until now; furthermore, perhaps a still voluntary but more collegial disciplinary sign-up at the workshop is necessary.

In some of the new rounds of mobile probes (RS3 from January 2016), it was found that it can be difficult for some participants to go beyond the descriptive level. Just as in face-to-face scaffolding, these participants require more time to reach the kind of reflectivity which is sensitive to the specific and/or extraordinary. Though a test to stretch the timeline was conducted, it seems that one of the limitations of mobile probes for some people is that it is easier to stop participating. Many issues could be at stake, including time-related priorities, lack of back-up from the organisation or simply the distance and digital nature of mobile probes, which can make it less natural and thus more difficult for some people to make a commitment. Research is therefore needed regarding why people refrain from starting and also the reasons why they drop out.

The current exemplary case, i.e. the RS3-pilot, resulted in the investigation of the 'good' case of mobile probes as a scaffolding activity in the time- and place-distributed environments of school teachers. The next sampling in this DBR project could be to investigate a 'not-so-good' situation that may shed some light regarding why early drop-out (deliberately and involuntarily) happens.

CONCLUSION

At the start of the paper, three research questions were formulated and are included here again to sum up what is now known.

What can be learned from mobile probes studies in the context of eLearning and professional development? Mobile probes are seen as useful for environments where the professional development activity is about content that teachers see, adapt and transfer to own work practice and where the tasks are carried out in different geographical areas and time intervals. The approach provides insights into the contextual situation via open and here-and-now questions, which enabled participants to evaluate what happened today rather than how things went one or two months ago, which is often the situation in courses, workshops etc. This pilot had very engaged teachers, but in the newer RS3 studies it proved to be difficult to get the participants started and sometimes to even engage in and complete the process.

How do the participants experience and change due to the mobile probes process? If commitment and motivation are present, the mobile probes process can support the teachers to change their practice and begin further collaboration in local settings. The mobile probes process and the OR try to address change and transfer to practice in

small incremental steps. The participants were very open regarding their activities and when reporting on their students' activities and own evaluation hereof. It can be difficult to move beyond the more descriptive level or to provide nuanced/full answers to mobile text questions. Also, the participants showed signs of productive frustration, but in the newest rounds there have also been signs of over-frustration.

What signs are there that the mobile probes scaffold learning? The open questions that served to uncover non-knowledge of the original mobile probes method as an empirical data gathering method, served in-line with a heuristic scaffold. The mobile probes enable participants to do a just-in-time reflection, and can support participants in the externalisation of metacognitive processes by prompting them to explicate and evaluate their own thinking and doing; however, the mobile probes process cannot document the sustainability of these self-regulations. As a professional development activity, the mobile probes focus on the teachers and their ability to self-report and to support self-scaffolding through an external heuristic scaffold. The approach has an explicit focus on signs of transfer, where the signs are seen in the teacher's answers.

The conclusion is that the mobile probes can function as a scaffold for learning at the individual and peer level. The probes can create a space for teachers to explicitly reflect on their own teaching processes and try out small things. In the future of this project, reasons for opting out and dropping out of this volunteer teacher professional development activities will be investigated. This can create knowledge both for research and future design in general, and in the project this will be related to both an individual, peer and organizational level.

REFERENCES

References can be found in the dissertation's literature list.

10.2. KEY CONTRIBUTION AND IMPLICATIONS FOR DESIGN

The mobile probe intervention was initiated to gather data for RS3. It also turned out to be an effective scaffolding intervention, encouraging the teachers to act and reflect. This finding contributes to the dissertation focus, because it offers a way to use technology to scaffold practitioners in situ to initiate and possibly sustain change without the presence of a human facilitator. An additional affordance of mobile technology for PD is that it enables continuity between contexts and learning-in-context, which, in turn, can provision just-in-time learning support (Ciussi, Rosner, Augier, & Suder, 2011). RS3 indicates that mobile probe technology can be part of such a PD learning design by addressing some of the issues explored in this dissertation; specifically, mobile probes can be viewed as a technology that contributes to timely scaffolding in and around PDI activities.

As Ciussi et al. (2011) noted, mobile technology facilitates access to internet services, providing an enormous increase in quantity of information that does not necessarily correspond to a similar increase in quality. Building on this observation, mobile technology can deliver learning opportunities in new ways and places, yet with the abundance of information available, the value of education and learning services may lie not in their ability to *provide* content but in their ability to *curate* learning content.

Article C focused on RS3 and also reported findings from RS1 and RS2; thus, the article serves to consolidate the overall DBR study. Chapter 11 continues along these lines by providing the status and conclusions on the KpN TPD case of this dissertation.

CHAPTER 11. CONCLUDING THE TEACHER CASE

The KATA Foundation aimed for KpN to become a stand-alone oTPD that could potentially reach all Danish science teachers and advance their science teaching practices. As such, the intent was that science teachers would collaborate on completing KpN at their schools without support from the KATA Foundation. The results from RS2 (Chapters 8 and 9) and RS3 (Chapter 10) shows that teachers' engagement with the KpN process and learning content can positively impact teaching. RS2 highlighted the concern that KpN would have only a minimal impact on teaching practices as a stand-alone due to the criticality of personal commitment to the researcher in RS2. This was later confirmed in RS3 as teachers proved reluctant to engage with KpN on their own, even when the learning process was supported by in-person seminars.

Despite its ongoing smaller iterations and additions to content, the KpN oPDI has been ineffective in advancing teaching practices at scale, primarily because of the lack of participation. The findings in this dissertation make it reasonable to question the extent to which participation in KpN would result in changes in teaching behaviors and advancements to practices. Chapter 12 discusses this further.

11.1. A LIGHT IN THE DARK

In February 2016, a new course was launched on the KpN platform. The new course helps teachers understand and prepare for a new mandatory 9th grade examination that is fundamentally different from the current examination form. The new exams will take place starting April 1, 2017; 9th grade science teachers have to amend their planning and execution of teaching well before this date to prepare students for the exam.

From KpN's launch in August 2014 until the 9th grade examination course launched in February 2016, there were 229 registered teachers on the KpN platform; *registered* means that the teachers have created a profile on the platform. By August 2016, there were 582; hence, the number of registered teachers accumulated over 18 months had more than doubled within 6 months. This increase is due to the new learning course, which has received more attention than any of the previous courses. The KATA Foundation and I have become increasingly aware of the great difficulty of "convincing" teachers of an externally viewed need for change. On the other hand, and exemplified by the new KpN course, once the need is recognized and change is perceived as an unavoidable, urgent requirement, change is likely to be initiated. This underlines the need for oPDIs to create immediate value, with value defined by the

practitioner; this echoes the finding that teachers will embrace change despite overall resistance when oPD helps them solve current tasks and challenges (Section 9.1). This will be further discussed in Chapters 12 and 13.

11.2. GOING FORWARD

The KATA Foundation continuously works to find ways to add value to schools and the teaching they deliver. All KATA projects are handed over to an implementation partner who can create the most value possible for Danish science teaching. KATA is currently looking for the ideal implementation partner for KpN, a partner who would be given all rights and resources, provided that the partner lives up to a number of objectives aimed at making KpN as influential as possible. One of the partners under consideration delivers content and structure for teachers to prepare their teaching. This partner has grown increasingly popular with the teachers. Integrating KpN material that promotes inquiry-based methods into the partner's content base could influence science teaching through an already perceived need for the material the partner provides.

This brief status on the KpN intervention investigated in the DBR project supports the understanding that teachers' perceived needs and definitions of effectiveness are critical to participation and for intervention-based change to occur.

CHAPTER 12. TAKING A STEP BACK: THE PROCESS OF INTERVENTION-BASED CHANGE

In Chapter 12, the knowledge gained in the literature reviews and the empirical studies first come together in a model of intervention-based change in Article E. The article challenges the assumptions linked to the effectiveness of oPD interventions and their implementation, which enables a rethinking of the means by which we utilize online technology to advance work practices. Hence, this chapter addresses all three research questions, but in the conceptualization of the intervention-based change model, it specifically addresses the second question: When and under which conditions can oPD be effective in advancing work practices? The chapter also offers a glimpse at an alternative technological approach to PD effectiveness (research question 3) that will be further explored in Chapter 13.

As discussed in Article A (Section 2.1), the effectiveness of e-Learning is most commonly evaluated comparatively; that is, the research question becomes whether or not e-Learning is more, less, or equally effective in comparison with face-to-face instruction. The comparison of the two modalities – face-to-face and its online replica – diffuses the underlying assumption that instruction is the most effective means to learn and advance practices. Quantitative research on the effectiveness of e-Learning uses the comparative method to control variables through course similarities, leaving "online vs. face-to-face" as the independent variable and the dependent variable as, for example, learning outcome to represent effectiveness. Although quantitative comparative studies are preferred for publishing (ref. publication bias; Article A, Section 2.1), the knowledge yielded does not address the question of whether an instructional learning design in course format is the most effective approach in the first place. Hence, the comparative methods do not address variations in strength and limitations of the modalities outside the realm of instructional practices. This is especially problematic for PD, because the aim is to advance practices, which may not be achieved though formal instruction of any modality.

An alternative approach to quantitative comparative studies of different modalities is to take a step back and thoroughly investigate the motivations and scaffolding needed to initiate and sustain practitioner change. Only after such investigation would considerations of the modalities assisting in the change process be valuable. Article E aims to contribute to this investigation.

12.1. ARTICLE E

Advancing Work Practices: Rethinking Online Professional Development in the Context of Intervention-based Sustainable Change.

Author: Signe Schack Noesgaard

The article was published in the journal *Interactive Technology and Smart Education*, 2016, Vol. 13, Issue: 4, p. 246 – 260.

A similar conference article was published in the *Proceedings for the 10th International Conference on e-Learning 2016*. The conference was part of the Multi Conference on Computer Science and Information Systems 2016 (MCCSIS), Funchal, Madeira, Portugal. The conference paper was short-listed and an extended version invited for publication in *Interactive Technology and Smart Education*.

Advancing work practices

Rethinking online professional development in the context of intervention-based sustainable change

Signe Schack Noesgaard

Department of Learning and Philosophy, Aalborg University, Copenhagen, Denmark & The KATA Foundation, Sønderborg, Denmark.

STRUCTURED ABSTRACT

Purpose: To discuss the effectiveness of e-Learning in advancing work practices. The paper investigates the assumption that e-Learning is as effective as face-to-face interventions when stimulating change. It also examines the assumption that well-designed and well-executed instructional interventions will advance work practices.

Design/methodology/approach: The paper synthesizes contemporary social-psychological and educational research in the creation of a model of intervention-based change. In addition, the findings from an empirical study of online teacher professional development simultaneously inspire and exemplify the model.

Findings: The paper suggests that increased attention to individual motivational drivers is needed, especially post intervention, to help ensure meaningful the transfer of learning and sustainable behavior change. The importance of individualized on-the-job scaffolding for employees is highlighted through relational considerations of attrition and scaffolding. In investigating the chasm between initial and sustained change, seemingly unpredictable contextual factors appear to be critical to the effectiveness of e-Learning in advancing work practices.

Practical implications: In recognition of the vulnerability and situatedness of turning instructional interventions into sustainable change, the paper initiates a rethinking of e-Learning as technologies for on-the-job, just-in-time, and individualized performance support. The paper gives concrete examples of current technologies that may assist in online scaffolding, while also acknowledging that this is still a field in which further research and developments are needed.

Originality/value: The paper critically investigates some of the more resilient assumptions that serve as a fundament for professional development interventions today. It conceptualizes intervention-based change and the key motivational drivers of such change. In doing so, it illuminates highly contextual dynamics presumed to have a critical impact on the effectiveness of e-Learning for professional development.

ABSTRACT

Stand-alone e-Learning is unlikely to change work practices. This claim contrasts with a comprehensive body of research arguing that e-Learning is at least as effective as face-to-face instruction in improving work performance. Such a comparison is, however, problematic. On the one hand, it relies on the premise that face-to-face instruction is effective in changing work behaviors. This article argues that instruction—whether e-Learning, face-to-face, or a blend of both—cannot stand alone. Individualized on-the-job scaffolding of employees is needed for meaningful the transfer of learning and sustainable behavior change to occur. On the other hand, e-Learning can be as important as face-to-face instruction in preparing the ground for advancing work practices, when e-Learning is designed in acknowledgement of its strength and limitations. In outlining the above arguments, this article contributes a four-step model of intervention-based change. The model lists the key motivational drivers of employee persistence and commitment to change. The article illustrates e-Learning as an assimilative learning catalyst and offers an overview of the scaffolding needed for advancing workplace practices. Ultimately, the article discusses how a redefinition of e-Learning as just-in-time technologies for performance support can potentially provide scaffolding for employees to engage in sustainable change.

KEYWORDS

Professional Development, E-Learning, Persistence, Motivation, Scaffolding, Sustainable Change

Paper type: Research paper

INTRODUCTION

The only constant is change. This statement has its roots in Heraclitus' ancient Greek philosophy. It does, however, also describe a premise of work that many employees experience today: a new business strategy, a new manager, a new It system, new standards, and new procedures. Change is exciting and change is stressful. When external or internal pressure deems organizational change necessary, employees need situated support to reduce potential anxiety and to navigate new paths to individual and organizational performance. If only we could accomplish this by sending our employees on a course.

The objective of professional development (PD) is to advance workplace practices. Professional development interventions (PDIs) are often formalized courses that are comparable with those of higher education; however, another layer of complexity is added to PD as the objective is reached *after* the PDI has been completed. Hence, the end objective is not to learn certain concepts, which can be applied and assessed in a test; it is after those tests that the real learning challenges lie.

E-Learning for PD has become increasingly popular within organizations (Ho & Jones 2015). The prevailing e-Learning intervention delivers a self-paced instructional learning path with programmed and/or recorded content that often includes learner–material interactions with programmed feedback and multiple-

choice tests. Stand-alone means that there are no additional activities or processes added to the e-Learning course; it is self-contained. The popularity of using this form of e-Learning for workplace learning is related to an underlying assumption that e-Learning is as effective as face-to-face interventions. A comprehensive body of research supports this assumption (fx. Maloney et al. 2011; Jackson & Lichtenstein 2011). As a consequence, the aim of e-Learning becomes the digitalization of face-to-face training and the development of e-Learning *instead* of face-to-face training. Formalized instruction may, however, not have been the answer in the first place—at least, not the complete answer. Hence, in PD, the comparison between e-Learning and face-to-face instruction diffuses important discussions on the change needed, the possibility of change occurring, and whether instruction is the right means to achieve the objectives.

In light of the above concern, the purpose of this paper is to present a model for broadening the understanding of intervention-based change to individual employee behavior and to show how e-Learning can contribute in the process. Specifically, the paper is structured around the following research questions:

(i) What drives intervention-based change to work practices? (Section 2)

(ii) What is needed to ensure change to work practices? (Section 3)

(iii) Which roles can e-Learning play in the change process? (Section 4)

WHAT DRIVES INTERVENTION-BASED CHANGE TO WORK PRACTICES?

This paper presents an intervention-based change model (Fig. 1). The purpose of the model is to synthesize recent findings in social-psychological and educational research into an intervention-based change process with key motivational drivers for employee commitment to change and consequently highlight the complexity in changing work behaviors through PDIs.

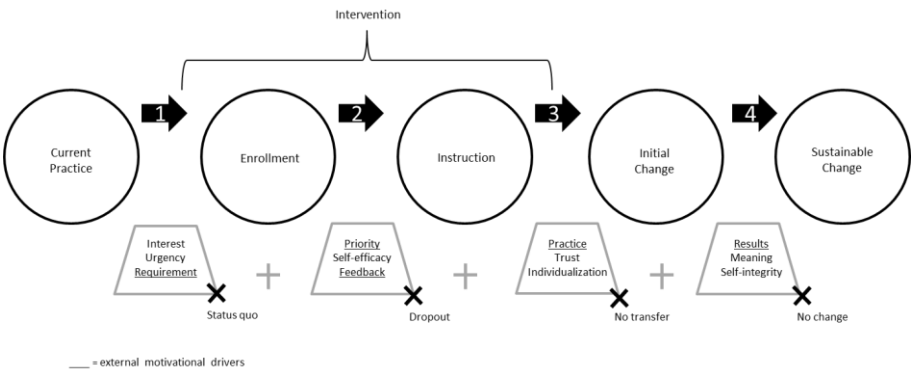


Figure 1. The four-step change process

The five circles in the model (Fig. 1) are components of the intervention-based change process. The arrows illustrate the critical steps in the process, while the trapeziums list the key motivational drivers that are critical to proceed to the next step. The X in each trapezium indicates the likely consequence of missing motivational drivers. Previous drivers should be added to each new list of drivers. As an example, an employee loses interest (step 1 driver) in the topic during the course (step 2) and drops out. Another employee experiencing the hardship of building new work habits (step 4) may terminate her efforts due to organizational changes at work, which no longer make the change a priority (step 2 driver). The intervention includes the enrolment in (circle 2), engagement with, and completion of formalized instruction (circle 3).

The drivers can be roughly divided into internal motivational drivers, fx interest and urgency, and external motivational drivers, fx priority and feedback (Halawa, Greene, & Mitchell, 2014; Lee & Choi, 2011). The external factors are underlined in the model. There is, however, a strong interrelatedness between external and internal drivers, and it can be challenging to decide whether a drop in commitment is caused by a drop in internal or external motivational drivers (Halawa et al., 2014).

The model is a simplification and generalization of extremely complex and heterogeneous human motivations, learning, and action; in many instances, the intervention and changes in work behaviors would be interwoven and the process more circular or spiral-shaped than linear. The simplification aside, the model illustrates how changing work practice is a challenging and vulnerable process that requires more than formalized instruction. Each step will be explained below before returning to this argument.

2.1 Step 1: Motivation to enroll

The first step in the model occurs when the employee decides to enroll in the PDI. The internal motivational drivers are the employee's **interest** in the content and sense of **urgency** to become competent in the field to sustain or increase work performance. As mentioned, the drivers uphold their importance throughout the change process. Thus, the employee's interest in the material must also be present during the intervention (step 2) because "*lack of interest can cause students to dedicate less time to the course, leading them to skip pieces of content, disengage from assessments, or simply proceed through the content at a slow pace"* (Halawa et al., 2014, p. 2).

A key external motivational driver ensuring enrollment and persistence is the **requirement** from a manager or workplace to participate in the PDI. The use of compliance and mandatory PD varies greatly from industry to industry; most employees do, however, experience participation in mandatory PD during organizational changes (Miller, Ho, Frankel, & Jones, 2014). A requirement to enroll, complete, and change practice will have a positive impact on persistence throughout the change process, especially when the alternative has negative consequences for the employee's job tasks or employment. Employee engagement and general performance may, however, suffer along the way.

2.2 Step 2: Motivation to engage and complete

The second step is where the employee engages in and completes the intervention. In addition to previous drivers, persistence requires that the participation take **priority** over other job tasks. A temporary decrease in workload can also allow for engagement in PDIs. Once the workload increases, however, the PDI may be down-prioritized, resulting in dropout. Participants in PD are primarily working adults with many responsibilities and distractions (Kaiden 2002). Hence, even when PDI initially takes priority over other tasks, priorities easily change. The low exit barriers for e-Learning means that the decision to leave can easily be provoked by any number of factors in the employee's life (Halawa et al., 2014).

Focusing on internal drivers, ability is an apparent predictor of persistence; low-performing participants tend to disengage more frequently than high-performing ones (Hoskins & Van Hooff, 2005). However, the effects of ability on dropout are mediated by the employee's self-perceived **self-efficacy**—the degree to which the employee believes that she can achieve a particular goal. Self-reported self-efficacy has predictive value for persistence and performance (Zimmerman, 2000). Though self-efficacy is widely accepted as a key driver of persistence, the timing of high self-efficacy in the change process could be important; high self-efficacy on PDI objectives *prior* to the intervention may undermine a sense of urgency to change, because the employee believes that she is already capable of and possibly already doing what is taught in the PDI. Hence, the employee must find the content sufficiently challenging to be worth the time investment, but not so challenging that content incomprehensibility and volume impede self-efficacy and knowledge gain. Individuals' self-efficacy is formed by their own interpretations of their performance and by social cues (Albert Bandura, 1982). Thus, **feedback** can be an important enhancer of self-efficacy. Effective task-related feedback generally contributes to performance improvement. To be effective, *"feedback needs to be clear, purposeful, meaningful, and compatible with (...) prior knowledge (...) It also needs to prompt active information processing on the part of learners, have low task complexity, relate to specific and clear goals, and provide little threat to the person at the self level"* (Hattie & Timperley, 2007, p. 104). Hence, effective feedback continues to be vital throughout the change process.

2.3 Step 3: Motivation to transfer and initiate change

In step three, the motivated employee initiates changes to his work. For more than a century, researchers within the field of the transfer of learning have discussed this process: how knowledge and skills learned in one instructional context can be applied in another context, such as the workplace. There is, however, little agreement among researchers about the nature of the transfer of learning, the possibilities of its occurrence, and the mental or social mechanisms that may underlie the concept (Lobato, 2006). That said, several researchers agree that employees should **practice** new skills both during and after the intervention and, thus, be able to immediately act on the new learning (Wahlgren & Aarkrog, 2012). The employee must be motivated to practice, which requires actionable PDI instruction and a supportive work climate

that prioritises the change (Herrington, Herrington, Hoban, & Reid, 2009; Noesgaard, 2014). The initiation of change depends heavily on the level of **trust** the employee perceives to be present at her workplace. Experiences of incompetence occur when initiating change in behavior, and practitioners are reluctant to adopt new practices unless they feel certain they can make them work (Guskey 2002b). If an organization punishes those who make mistakes and take risks, the employees will, thus, be reluctant to initiate change (Kousholt, 2009). Trust has been overlooked in work situations but is a significant factor in PDI persistence and learning (Short, 2014).

In step three, **individualization** of the learning objectives and content becomes critical for employee motivation. The employee needs to find a meaningful blend of the PDI proposed changes and the specificities of the individual work context to advance her work performance. Hence, it can be reasonable to allow employees to define their own goals and both challenge and support them when doing so (Blondy, 2007). Employees do not transfer learning directly to their work practices (Noesgaard & Ørngreen, 2015). Consequentially, insisting on transfer per specification may prove to be counterproductive for employee motivation to change.

2.4 Step 4: Motivation to sustain change

The fourth step turns initial change into sustainable change. This part of the change process is based on Thomas Guskey's model for teacher change (Guskey 2002b), in which he shows that practitioners commit to PDIs and change practices sustainably only when they experience positive **results** from the initiated change. This runs counter to a general understanding that practitioners commit to changing work practices during PD (Guskey 2002b). Instead, it is the unpredictable on-the-job reactions to the initial change, fx students' inactivity or a customer's increased engagement, that determine whether or not the employee finds **meaning** in the initiated change and consequently sustains it.

Numerous epistemologically diverse theories of learning underline how accommodating our habits and beliefs to new evidence not only makes creativity, learning, and change possible but this accommodation can also be a very difficult, frustrating, and painful process (fx Engeström & Sannino 2010; Mezirow 1997; Cohen & Sherman 2014). Through the lens of frustration theory, employees become frustrated when they anticipate positive results in their practices after PDI but find none. Frustration left unmanaged easily obstructs initiated behavior change (Amsel, 1992). It often entails an element of discomfort when an employee is led to question his practice as the most fruitful way to foster results. Thus, employees may also become frustrated and disengage, because the initiated change conflicts with their beliefs and current practices; thus, posing an identity threat. Self-affirmation theory specifies how the individual needs to uphold his sense of **self-integrity**; to perceive oneself as morally and adaptively adequate: *"the self-integrity motive is so strong that even mundane events can threaten the self as well as instigate defensive responses to protect it"* (Cohen & Sherman, 2014, p. 335). Providing self-affirming interventions, which focus the individual's attention on his values and capabilities unrelated to the changing work tasks, may ensure the employee's self-integrity and openness to change.

2.5 Empirical support for the model: Advancing science teaching

The intervention-based change model is largely a product of the findings from an in-depth qualitative empirical research study conducted with Danish science teachers participating in an e-Learning intervention intended to improve Danish K–5 science teaching. The chart below (Fig. 2) is a snippet of data from this study. Ann, Lillian, and Julia (pseudonyms) are middle-school science teachers at the same school. They participated in a research study on the implications of an e-Learning PDI, which was conducted at three schools from February 2014 to June 2015 with a follow-up survey six months later (more on this study in Noesgaard & Ørngreen, 2015).

Observation and survey data were gathered in identical ways and weight before (PRE) and after (POST) the teachers interacted with the e-Learning (eL). In the chart (Fig. 2), each value on the x-axis (PRE1-4, eL, POST1-4) represents the teachers' weekly 90-minute science teaching, in which the classroom observation took place. The curves show the teachers' performance on behavioral learning objectives based on observation protocols and video recordings. The control line represents the other teachers in the study, who did not complete the same course elements as Ann, Lillian, and Julia but were evaluated on the same objectives. The e-Learning intervention included step 3 of the model (Fig. 1) as the learning process alternated between

1. instruction with theoretical knowledge, exercises, and practical tools;
2. guided preparation for classes; and
3. actual teaching, in which the change was initiated.

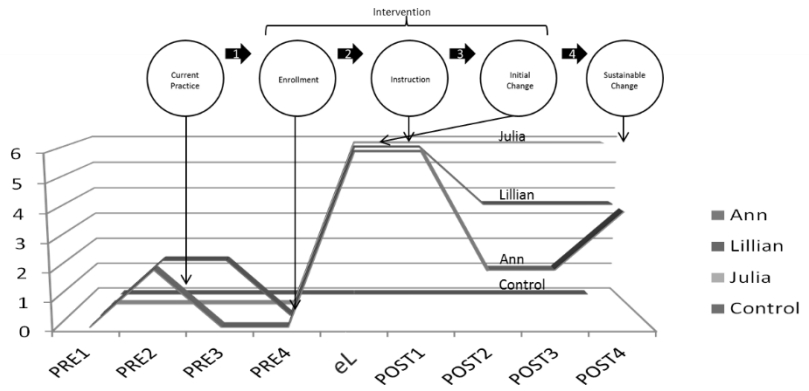


Figure 2. Exemplifying the model: e-Learning for science teachers

In the PRE phase (Current Practice, Fig. 2), Anna and Lillian performed on a few elements of the objectives, though the general picture shows little to no performance on the objectives. During the e-Learning (eL, Fig. 2), the three teachers fully performed on the learning objectives in their teaching. In the POST phase, the e-Learning had been completed, and there were no requirements for the teaching, but the classroom observation continued.

The differences in the POST phase were surprisingly apparent—also for the other teachers—despite high levels of similarity in teacher and contextual characteristics evaluated on self-efficacy, learning outcome, satisfaction, relationship with management, and approach to the PDI. Julia experienced a positive impact on the students during the in-class application and continued to use her new skills after completion, even applying her new questioning technique in her history classes. The follow-up survey indicated that Julia has sustained the change in her teaching. Lillian, conversely, became frustrated as her students reacted to the change in her teaching with inactivity. In this regard, the term "confused counterparts" was coined to acknowledge the observation that even change initiatives specifically intended to increase the counterparts' (i.e., students) engagement may result in confusion, awkwardness, and inactivity. This occurs because

> When teachers change their methods of teaching, they change the rules of interaction. If they are not informed about, accustomed to or able to understand their teacher's new way of posing questions, students may become confused, frustrated and disappointed, especially if they have worked out how to perform well under the previous rules of interaction (Noesgaard, 2016, p. 11).

The frustration Lillian experienced appeared to be due to her expectation of increased student engagement (as promised in the e-Learning) coming into conflict with her actual experience of decreased student engagement (more details in Noesgaard, 2016).

Both Lillian and Ann continued to apply only elements that were easy to assimilate to their current practice. The follow-up survey indicated that neither Lillian nor Ann is teaching as per the course objectives any longer. Hence, these seemingly similar teachers in very similar contexts, who completed an intervention based on transfer research, underwent very different levels (Fig. 2) and kinds of change. This is an example that supports Guskey's argument that sustainable change and commitment only occur when the initial change yields positive results, which in turn underlines the vulnerability of the initiated change.

2.6 A change in emphasis: From instructional design to in situ support

The influences of situated and unpredictable interactions on the effectiveness of PDIs has thus far been largely overlooked in research studies. Therefore, this issue will receive extra attention in this section.

First and foremost, the fourth step illustrates the hardship and vulnerability in achieving sustainable change as a result of stand-alone PDIs. One reason for this challenge may be the behavioristic assumption that well-designed and well-executed instruction will advance practices. According to Guskey (2002a, p. 382),

> Professional development activities frequently are designed to initiate change in teachers' attitudes, beliefs, and perceptions. Professional development leaders, for example, often attempt to

> change teachers' beliefs about certain aspects of teaching or the desirability of a particular curriculum or instructional innovation. They presume that such changes in teachers' attitudes and beliefs will lead to specific changes in their classroom behaviors and practices, which in turn will result in improved student learning.

The assumption that changes to attitudes and beliefs lead to change in practices reduces PD effectiveness to a question merely of PDI design. The assumption can also initiate a self-affirming ripple effect in which learning theories come to support the assumption. As an example, transformative learning theory states that transformative learning "…involves transforming frames of reference through critical reflection of assumptions, validating contested beliefs through discourse, taking action on one's reflective insight, and critically assessing it" (Mezirow 1997, p. 11). In the abovementioned assumption, transformative learning would then be expected to take place during the PDI and, in turn, change behavior.

When beliefs do not change before the practitioner has seen evidence of the PDI's effectiveness in their practices, a change in beliefs is primarily a result, rather than a cause, of a change in practices (Guskey, 2002a). From this perspective, the transformation of the frames of reference has only occurred when a positive change in practice has been proven to the teacher. Thus, the chasm between initial and sustainable change in the intervention-based change model (Fig. 2) entails the transformative potential. Evidently, this potential calls for a change of focus from a stand-alone PDI design to supporting the practitioner in finding what he/she perceives as valuable changes in, for example, student learning and engagement for the teacher, patient care for the nurse, and customer attitudes for the sales manager.

The teacher cases in the empirical study indicated that the kinds and amount of evidence required to sustain change and thus enable it to become a part of everyday practice vary from one case to the next. Guskey (2002) focuses on formal evidence of student learning, such as students' test scores, as evidence of the effectiveness of PDIs. The empirical study suggests that whether or not something is considered as evidence of the effectiveness of PDIs is subjective and contextual; as a result, there can be a great variety of experiences, which, to the outsider, may not appear to be caused by the PDI, but which are interpreted as such by the teacher (Noesgaard 2016b).

The novelty of the concept of "initial vs. sustainable change" in PD is underlined by its absence in the transfer of learning literature. The main aim of the transfer of learning literature is to bridge the chasm between PDI completion and the initiated change. Although some studies are indeed concerned with turning formal learning into long-term results (Noesgaard and Ørngreen, 2015), the situated pitfall specifically between initial and sustainable change has not been addressed. However, it is in this messiness of potentially frustrating lived professional practices that the evidence of the PDI's effectiveness is (or is not) created and resultantly change is sustained (Noesgaard 2016b).

Furthermore, the distinction between initial and sustainable change is essential, because the practitioner is challenged not only by the situatedness of PD's effectiveness, but also by a common unexpected dip in performance in the process of initiating change. Fullan (2001) refers to this as "the implementation dip," which "…is

literally a dip in performance and confidence as one encounters an innovation that requires new skills and new understandings" (Fullan, 2001, p. 40). People in the midst of the implementation dip experience fear of change and often lack the knowledge and skills needed to make the change work, as it requires them to question and change their understandings and behavior. In this process, they often feel confused, overwhelmed, and deskilled (Fullan, 2001).

In sum, the combination of the following three interrelated elements of this pitfall between initial and sustainable change are likely to contribute negatively to the effectiveness of PDIs:

1. the PDI instilled anticipation that initiating change will lead to increased performance;
2. the implementation dip that runs counter to this anticipation; and
3. the unexpected negative responses of the confused counterparts (e.g., students, patients, or customers).

WHAT IS NEEDED TO ENSURE CHANGE TO WORK PRACTICES?

In PD, there is often a gradual attrition of participants from enrollment over completion to change in work practice (fx. in Marsh et al. 2001; Maloney et al. 2011). Attrition need not be negative; the content may prove irrelevant to the employee after enrollment (step 2), or he immediately finds the exact advice needed. In such instances, the continuation of the PDI could be a waste of time. Many employees who disengage somewhere along the change process could, however, have benefited from persisting. The gradual attrition calls for increasing support throughout the change process, because it becomes increasingly difficult to persist as more motivational drivers are required. Simultaneously, the level of support decreases; often, there is no PDI-related support after the instruction is completed. Thus, the need for motivational support increases the further the employee gets in the change process.

The importance of follow-up in supporting change is well established in previous research; for example, scholars from the American Institutes for Research analyzed findings from over 1,300 studies that address the effect of teacher professional development on student learning outcomes. Virtually all of the studies that showed positive improvements in student learning included significant amounts of structured and sustained follow-up after the main professional development activities (Guskey and Yoon, 2009). Of course, follow-up is not a panacea guaranteed to improve performance. Planned follow-up sessions may improve learning retention, commitment, and even the translation of learning into practice. Often, however, follow-up consists of pre-planned instructional initiatives, which are not necessarily sufficient for providing individualized and contextualized support and challenges for the employee. Timely scaffolding can, however, assist in managing and challenging frustration and potential change avoidance in the zone of proximal development (Vygotsky, 1978) to ensure the change works for the practitioner and the potentially confused counterparts. Simultaneously, affirmative support is critical to allow those engaged in the difficult process of implementation to tolerate the anxiety of occasional

failures (Guskey, 2002). This scaffolding support of eemployees' change efforts must be highly individualized, because they vary greatly in terms of their ability to self-regulate: to control thoughts and actions despite the presence of disruptive impulses. An individual's level of self-regulation applies not only to current situations but may "*also influence the decision about whether to enter into various situations or not in the first place*" (Baumeister, Heatherton, & Tice, 1993, p. 141). Highly self-regulated employees may persist through formalized learning and, consequently, advance work practice without additional support. Many employees will, however, disengage when the PDI, for example, proves more time-consuming than anticipated (priority–step 2 driver) or poses a threat to their professional identity (self-integrity–step 4 driver). In frustrating situations of feeling incompetent due to no or negative impact on practice, even highly self-regulated individuals find reason to return to the status quo.

The increased need for individualized support makes scaffolding an effective strategy. Scaffolding is providing support at the individual level of the employee's current skill while she is carrying out the task, and then gradually fading out the support (Järvelä, 1995). "*A scaffold is, by definition, a temporary entity that is used to reach one's potential and then is removed when learners demonstrate their learning"* (Lajoie, 2005, p. 542). Inspired by Vygotsky's (1978) conception of the zone of proximal development, individuals are viewed as having learning potential that is immediately outside of their comfort zones and that can be reached through competent scaffolding by, for example, managers or coaches.

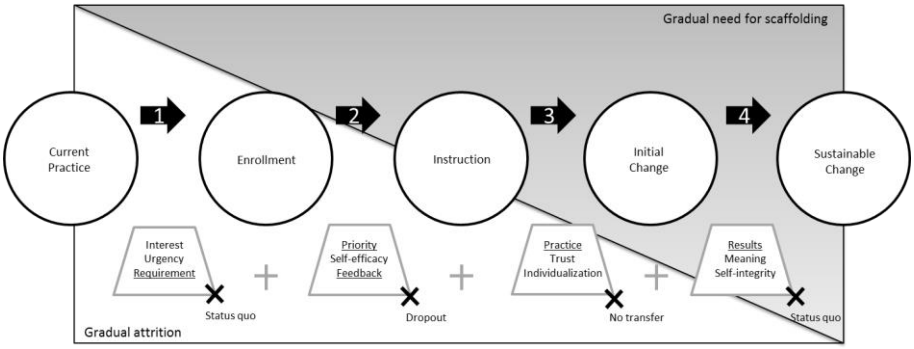


Figure 3. Gradual attrition vs. gradual need for scaffolding

In the model (Fig. 3), a rectangular background to the four-step change process has been added. It illustrates how resistance to gradual attrition requires increasing levels of scaffolding. This relationship is naturally simplified and is unlikely to be linear. In addition, attrition is relevant at the group level, while the change process highlights individual motivations. Nevertheless, scaffolding, which is competently directed at the drivers, is likely to have a positive impact on employee persistence because the extent, length, and technique of support can be tailored to levels of self-regulation and individual motivation (Lajoie, 2005).

PDI aims to positively impact complex real-world settings and *c*. On-the-job scaffolding will, thus, not inevitably ensure advancements but may contribute positively to employees' change efforts.

On the one hand, PD e-Learning as a stand-alone intervention, in which the practices of the target audience are generalized and no post-course scaffolding is in place, faces a double chasm between the intervention and initiating change (step 3, Fig. 2) as well as between initial and sustainable change (step 4, Fig. 2). Face-to-face PDIs have more opportunities for transfer planning and tailoring to individual needs, but they too are faced with the double chasm. On the other hand, such stand-alone PDIs, irrespective of modality, are not the site of the greatest challenge. Guskey (2002c) states as follows:

> If change in teachers' attitudes and beliefs occurred primarily before implementation of a new program or innovation, the quality of the initial training would be crucial. But (…) change occurs mainly after implementation takes place and there is evidence of improved student learning, continued follow-up, support, and pressure following the initial training that is even more crucial.

Thus, the PDI as a stand-alone intervention is inadequate for achieving sustainable change; however, provided that the needed situated scaffolding is in place post course (or in between course elements), the content can potentially be equally effective when delivered either face to face or via an e-Learning PD.

WHICH ROLES CAN E-LEARNING PLAY IN THE CHANGE PROCESS?

Compared to face-to-face interventions, e-Learning persistence is extra challenging due to the need for self-regulation combined with low entry and exit barriers. Looking at learning potential, however, several studies find that self-paced e-Learning can effectively convey material for lower-level learning, such as memorization and procedural knowledge (Hofmann 2006). Even in processing difficult material, e-Learning can assist through worked examples that provide structure and sequence, thereby reducing employees' cognitive load (Kachelmeier, Jones, & Keller, 1992). Hence, stand-alone e-Learning can offer inspiration, information, and standardized feedback, extending knowledge on subject matter, processes, and procedures. Therefore, e-Learning can be an assimilative learning catalyst that effectively prepares the ground for changes in practice.

This paper has argued that e-Learning is unlikely to result in changes to work practices on its own, not because it is e-Learning but because formal instruction in any modality cannot stand alone in change efforts. However, when organizational decision makers assume that well-designed instruction will advance work practices on its own, investments in scaffolding initiatives are logically considered an expensive noncritical add-on to training and, consequently, cut off the intervention chain. Ideally, the costs of scaffolding employees to sustainable change should, however, not be compared to the costs of stand-alone instructional initiatives, which, in themselves, rarely advance work practices. Acknowledging this premise, some suggestions for lowering the direct and alternative cost of scaffolding may include 1) using the

majority of PDI investments on on-the-job scaffolding instead of lengthy formal instruction; 2) using e-Learning snippets for retention and assimilative learning purposes; and 3) investing in scaffolding of employees' change processes for business-critical or strategic change initiatives.

At face value, on-the-job scaffolding is not scalable. Despite breakthroughs in machine learning and artificial intelligence, the in-person commitment (supporting persistence) and individualization (supporting meaningful change) cannot be fully and meaningfully turned into algorithms. Scaffolding may, however, become simultaneously effective and cost-efficient through the use of technology. Online coaching and follow-up have been effective in ensuring completion of PD tasks and achieving work-related goals (Poepsel, 2011). Mobile probes, which are personal text messages with questions or tasks, can provide a scaffolding experiences of *"gentle, but also disciplinary, reminders to act and reflect"* (Ørngreen et al., 2016, p. 8). In addition, scaffolding and assessment are two sides of the same coin; employees are continuously assessed to determine what type or level of scaffold is sufficient to help them reach their potential (Lajoie, 2005). Hence, formative digital assessment tools could advance both scaffolding and learning evaluation.

As long as PD is kept within an instructional framework, well-designed and well-executed instructional interventions will result in increased work performance and formal learning and evaluation design will continue to be the main concerns of PD. PD professionals will continue to struggle to find valid and meaningful ways to achieve the ideal instructional learning design—often by means of strategic and structured formal training sessions based on competency frameworks with tests and surveys to measure learner satisfaction and learning outcomes. Interventions proven effective in academic settings, such as gamification and adaptive learning, may not be adequate for advancing professional practices in the same form. Instead, PD professionals may want to leverage the way most practitioners have seamlessly integrated technologies into their everyday lives, which may be more effective in changing behavior than any instructional PD courses.

Such technological tools cannot ensure performance increases in isolation, but as elements in adaptive learning technologies, they may prove the value of less instruction and more just-in-time and just-for-me performance support.

Broadening its definition to include scaffolding technologies, e-Learning can be the provider of critical content *and* scaffolding in a multitude of fashions. When we start thinking of e-Learning in these ways, we are closing in on answers to employee growth and performance in both meaningful and scalable ways.

CONCLUSION

This paper investigated the assumption that e-Learning is as effective as face-to-face interventions when stimulating change. A four-step change process was presented illustrating key challenges and vulnerabilities of intervention-based change. E-Learning can play an important role in the change process, though it highlights that sustainable change requires more than the formal instruction of any modality. Instead of evaluating e-Learning in the light or shadow of its instructional alternative—face-

to-face-instruction—the paper suggests that educators, managers, and employees themselves focus on the change needed and the motivational means to accomplish it. This change in perspective can open up to potentially simple and financially feasible technologies that scaffold employees to continuously advance their work practices.

PDIs do not change practice; the employee does. Therefore, this paper has focused on individual motivations for change. A key argument has, however, been that change does not occur in a vacuum that we can control or design. Thus, an extension of the paper would benefit from elaborating on group dynamics and from adding theoretical models of organizational learning and change. In addition, further research on e-Learning and technological developments can investigate the extent to which in-person situated scaffolding can be digitalized to advance work practices, thus finding scalabilities in and around the seemingly non-scalable.

The contribution of this article has largely centered on a critical investigation of instruction as the means to advance practices. In the hope that further research will elaborate the assumptions underlying PD, the following questions may assist in reexamining the premise that PD advancing practices requires delivering content by means of *instruction* (as discussed in this paper) in the format of *interventions* to be *implemented* in practice. With regards to *intervention*, do we want to *intervene* in the jobs of the employees or support their performance? With regards to implementation, it can, on one hand, be a valuable acknowledgement that intervention-based change does not occur automatically. On the other hand, the term "implementation" implies that something will be put into effect—and is thus not currently "activated" in practice. Instead of delivering instructional interventions to be activated, could PD consist of something that *begins* by activating certain behaviors? Could e-Learning for PD be situated support that leverages the knowledge and experiences of the "confused counterparts"? Further investigation of these and related questions may turn out to be the cornerstone in advancing work practices through intervention-based sustainable change.

ACKNOWLEDGEMENTS

This research is funded by the KATA Foundation, Denmark and Innovation Fund Denmark. I am grateful to Professor Rikke Ørngreen for her careful reading and insightful comments on a draft of this paper.

REFERENCES

References can be found in the dissertation's literature list.

12.2. KEY CONTRIBUTION

Article E explored the discussion on measuring effectiveness comparatively initiated in the literature study (Article A, Section 2.1) and problematized instructional e-Learning as a stand-alone approach to advance practices. The article proposed that such e-Learning is unlikely to change practices sustainably, because formal instructional design cannot stand alone in change efforts.

The divide between initial and sustainable change was conceptualized in Article E. The concept brings a frame of reference for understanding the shortcomings of "the transfer of learning" in explaining oPD effectiveness in advancing practices. Classical transfer of learning only accounts for bringing change to practices and not necessarily for sustaining it, nor for evaluating whether the change is an advancement. Bridging the divide between initial and sustainable change, on the other hand, fully depends on how the practitioner perceives the change's effectiveness; thus, the practitioner becomes a gatekeeper for ensuring that change is only sustained if it constitutes an advancement from the individual practitioner's position.

The practitioner may, however, miss out on advancements because of temporary elements, which combined prove the oPDI ineffective in the eyes of the practitioner; these three interrelated elements present in the pitfall between initial and sustainable change are: 1) the PDI-instilled anticipation that initiating change will lead to increased performance, 2) the implementation dip running counter to this anticipation, and 3) the situated unexpected negative responses of the practitioner's counterparts (e.g., students, patients, or customers).

The assumption that many participants who terminate their change efforts could have benefited from persistence calls for increasing support and pressure throughout the change process. As mentioned, the level of support often decreases when instruction is completed. Persistence "in the pitfall" necessitates increasing scaffolding efforts as the process becomes more individualized and the meaningfulness of change becomes more subjective and contextual. Scaffolding is not a panacea, however; it can impede learning if not competently adapted to the individual and the situation.

12.2.1. IMPLICATIONS FOR DESIGN

Corresponding to the three contributors to the pitfall between initial and sustainable change, design may consider preparing practitioners for the implementation dip and providing scaffolding in situ to bring attention to minor and short-term results. Moreover, anticipating negative responses of the practitioner's potentially confused counterparts by including them in the interventions.

Article E concludes that online PD needs rethinking for intervention-based sustainable change to occur. The article suggests rethinking e-Learning as online just-in-time

tools for performance support, rather than viewing it as a stand-alone replication of face-to-face instruction. As such, e-Learning – defined here as online PD technologies – can contribute to the scaffolding follow-up post-intervention, for example, through online coaching, digital assessment tools and mobile probes. Such rethinking of online PD may provide critical, albeit incremental, change, thus heightening the effectiveness of PDIs. Breaking out of the instructional framing of PD may take PD to a whole new level; Section 12.2.2 is an attempt to do this.

12.2.2. TECHNOLOGIES FOR SITUATED ONLINE PROFESSIONAL DEVELOPMENT

At several points, the dissertation has implied the superiority of in-person scaffolding to digitalized scaffolding (e.g., in the discussion in Article A: Section 2.1), but it has also suggested that technology can take on a scaffolding role. Digital scaffolding can be combined with in-person scaffolding where, for instance, an in-person coach is given real-time information online in order to support practitioners to develop professionally with their counterparts and their continuous contextual challenges. Regarding technological advancements applied outside the realm of PD, research on virtual humans can bring an alternative perspective to the need for in-person scaffolding resources. One study investigates a virtual psychologist in action and shows that her greatest asset is that she is *not* human:

> [C]ompared to those who believed they were interacting with a human operator, participants who believed they were interacting with a computer reported lower fear of self-disclosure, lower impression management, displayed their sadness more intensely, and were rated by observers as more willing to disclose. (Lucas, Gratch, King, & Morency, 2014, p. 94)

The virtual psychologist exemplifies how technology can make the interpersonal interactions more distant, but it underlines how this distance need not be a disadvantage. Instead, technology can serve as an important mediator in tense situations that are everyday lived reality for many practitioners (teachers, managers, doctors, etc.). OPD could potentially serve as a medium to provide actionable information in a way that both addresses and lessens relational tension by enabling discussion of experiences and tendencies instead of giving feedback at the self-level, which may impede development (Hattie & Timperley, 2007). Rethinking instructional stand-alone oPD courses into committing technological frameworks may provide an unprecedented medium for adding value to face-to-face professional encounters between practitioners and their counterparts.

Technology can also potentially facilitate the interpersonal commitment needed to support the learner in persisting through the contextual challenges of initiating and sustaining change. Analogous to Michel Foucault's (1975) Panopticon, contextual online PDIs can alert a facilitator or coach to provide personal support when the

analysis of continuous data gathered deems it necessary; in this manner, the practitioner may experience ”the invisible, constant presence” of a coach even when the coach is merely following up on automated system alerts. Mobile probes may contribute in this “absent presence.” While the surveillance analogy unavoidably runs counter to a contemporary celebration of intrinsically motivated individuals, it could be further investigated as a potential for timely and supportive scaffolding, enabling the participant to feel committed to change.

Even when design takes the context into careful consideration, the unpredictive interactions influencing oPD effectiveness, the need for individualized scaffolding, and the need for real-time support call for highly adaptive oPD.

12.2.3. ADAPTIVE LEARNING TECHNOLOGIES

Given the pace of technological innovation, the technologies suggested for oPD in this section are integrally fallibilist. That said, online technology has become sufficiently advanced to be alternatively leveraged for PD to adhere to the elements of situated oPD. The advancements and use of adaptive technologies (and intelligent tutors) in education have increased during recent years. Wakelam, Jefferies, Davey, and Sun (2015) explained how adaptive learning systems “adjust the learning experience based upon the student’s progress, increasing the level of difficulty when they’re progressing well, and slowing down if they need further instruction” (p. 7). Adaptive learning systems can lower training costs, accelerate training delivery, and enhance personal learning experiences, yet Wakelam et al. (2015) found that relatively few comprehensive adaptive learning systems exist.

While adaptive learning systems for PD are scarce, they can potentially adhere to some of the design concerns and suggestions raised in the dissertation by 1) delivering personalized learning journeys, 2) showing and acting on progress of learning, 3) scaffolding the learning, and 4) potentially managing frustration by lowering the difficulty or changing the learning approach when needed. However, when developing adaptive technology for PD, it becomes critical to challenge the prevailing assumption that well-designed courses and high cognitive learning outcomes will guide action and lead to change in practices, as discussed in Article E (Section 12.1); the potential of adaptive learning technology would be overlooked if solely activated within the course framing. Situated oPD challenges this framing to leverage adaptive technologies in the messiness of changeable work practices. Hence, adaptive just-in-time learning technology would build on continuous information about practitioners’ past performance, the situation, and the needs of the counterpart in the context of the specific activities in which they interact – *when* they interact.

In adaptive learning solutions, the participants’ interactions with learning content (stimulus) are continuously processed into assessments of competence level, which results in presenting content that is most appropriate for the level of competency

(response). Thus, adaptive learning design can be viewed as behavioristic. I have presented adaptive learning technology as an opportunity to support situated oPD characterized by unpredictability. Placing unpredictability on a behavioristic algorithmic "formula" sounds like a contradiction in terms, but adaptive content generation for PD should be based on data on the practitioners' and counterparts' contextual experiences instead of their interactions with academic content. In addition, machine learning algorithms can potentially find surprising variations and patterns in data, posing an opportunity for algorithms to surprise human assumptions and determinism. While adaptive learning technologies can become digital scaffolding resources, potentially making the personal facilitator obsolete, adaptive learning could qualify and strengthen personal encounters between the practitioner and their counterparts by providing actionable information and learning in a timely manner.

For Danish teachers, an adaptive technology that can reduce teaching preparation time by providing teaching content and structure based on both the teacher's and the students' competency levels and interests could prove valuable. This is especially true at this historical juncture of reform implementation, when many teachers feel overworked and underappreciated. Teachers may perceive the introduction of a completely new technology as extra work and thus offer resistance, especially when faced with the continuous performance assessments needed for competent scaffolding. Thus, the KATA Foundation may be well advised to integrate KpN with already accepted and valued technology instead of developing new adaptive technologies at this point in time.

A new adaptive just-in-time technology based on situated PD may become effective in positively influencing PD in a variety of practices, because the utmost sensitivity to the specificities of individual practices and practitioners is an integral part of situated oPD. Arguably, situated design principles (to be presented in Chapter 13) may be of most relevance for practitioners whose job characteristics resemble those of Danish teachers, as the principles are derived from Danish teaching practices. The implementation of an adaptive PD technology would, however, also benefit from its users being accustomed to and demanding of technologically mediated PD. Team leaders in private corporations could be a relevant group of practitioners for extending the findings; team leaders manage teams (authority) separately from peers (practice alone) and have the autonomy to lead the team and its tasks (autonomy) but must adhere to company standards and will be measured on the results their team delivers (adhere to standards). As such, they share many working conditions with Danish teachers, although young team leaders are generally more accustomed than teachers to being evaluated on their performance, especially in private organizations. The empirical studies of Ciussi et al. (2011) cautioned against presuming that all of Generation Y is technologically affluent. In addition, young people do not necessarily demand novel and innovative technologies, but they do have high expectations for their reliability and ease of use (Jefferies & Hardy, 2010). Bearing these precautions in mind, young 'digital native' team leaders' technological affluence and demands

will vary, though they will increasingly expect real-time mobile analytics "with context-aware intelligence that helps, enriches, and speeds whatever tasks are at hand" (Workday 2016, p. 2).

A novel approach to leadership development focusing on new-in-role team leaders is called for; Workforce surveys repeatedly show a high level of disengaged employees in Danish and international organizations; in 2013, this statistic was 69% in Denmark (Gallup Consulting, 2013). The employee's relationship with the manager (or lack thereof) is repeatedly singled out as the most importance influencer on employee engagement, just as the teacher is the most important influencer on student engagement and performance (see "The Challenge", p. 59). According to Schein (1992), it is low- to mid-level managers who primarily influence subordinates and their stress and health outcomes (Nyberg, Bernin, & Theorell, 2005), yet their professional development is often deprioritized to higher management PD. It is also well established that employees develop most within the early years of practicing their profession (TNTP, 2015). As such, team leaders appear to be an ideal initial group for extending the design theory of situated oPD, which will be presented at length in Chapter 13.

As a suggestion to a specific PD design for team leaders, an adaptive just-in-time oPDI could, for instance, take care of all the logistics and documentation involved in the preparation, execution, and follow-up for biweekly or monthly 1:1 meetings with their employees. Based on the evidence-informed parts of situational leadership (e.g., Thompson & Vecchio, 2009), a mobile adaptive technology could ensure that the employee prepares for each 1:1 meeting first, and the manager prepares thereafter. In preparing, the team leader would receive learning materials and actionable information tailored to the team leader's and employee's needs and professional developmental levels. As the team leader's continuous "companion," the oPD learning technology could send reminders with key action points immediately before the meetings and follow up immediately after meetings to assess engagement and skills. These assessments could provide the team leader with real-time information and scaffolding. Such technology could potentially strengthen manager–employee relationships as well as employee engagement and performance, although this is yet to be investigated.

By synthesizing the empirical results of the PhD research into an intervention-based change model, Chapter 12 discussed the condition under which oPD can be effective in advancing practices (research question 2); this led to critical reflection on the adequacy of advancing practices by means of stand-alone PDIs. Chapter 12 went on to propose initial suggestions for *how* oPDIs can become effective in advancing work practices (research question 3). Rethinking of oPD into adaptive just-in-time PD technologies adhering to situated oPD design principles may, however, result in a renaissance for stand-alone oPD. Chapter 13 presents the design theory for situated oPD including these design principles.

CHAPTER 13. A DESIGN THEORY OF SITUATED ONLINE PROFESSIONAL DEVELOPMENT

A design theory of situated oPD will be presented in this chapter. The theory entails novel design principles, which are discussed with the findings presented in this dissertation. A theory of situated oPD proposes possible answers to the dissertation's third research question: How can oPD interventions be effective in advancing practices? Of course, as with the conditions under which oPD can be effective (research question 2), the designs through which oPD can be effective are too complex to fully illuminate. The PhD project has, however, found numerous novel aspects of oPD effectiveness that are relevant to consider for design.

The dissertation has found that traditional instructional design cannot sufficiently support the advancement of practices. This is due not only to the challenges of achieving initiated change (the transfer of learning) but to the contextual vulnerability and unpredictive results of initiated change. Hence, the design principles enlisted in this chapter all speak to situated learning and performance support and are heavily intertwined and interdependent. These new design principles do not render the KpN design principles irrelevant; instead, the new design principles add situated perspectives to advance the KpN principles into procedures that carry designs beyond the instructional course formats, a format to which KpN adhered, despite its innovative elements.

Contrary to principles for universal (instructional) designs applicable to any practice, the design principles constitute a fallibilist high-level frame for embracing the complexity and specificities of practices influencing the effectiveness of oPD.

The design principles are presented in Table 8. The *procedure* for each principle comprises the "implication for design" sections listed at the end of the dissertation chapters, and the *argument* summarizes the "key contributions" sections of the dissertation to the extent they impact design. The explanations of the principles are expanded and extending perspectives added in the text below Table 8.

Table 8. Design Principles for Future oPD Design

CHARACTERISTIC	PROCEDURE	ARGUMENT	SECTION
CONTINUOUS	oPD content is integrated into key job tasks and processes.	Integration ensures coherent and continuous development in changing contexts.	8.3 12.1
TIMESAVING	oPD content helps solve key tasks and challenges faster.	If oPD is perceived as time-consuming and adding to practitioners' workload, it is likely deprioritized.	5.2.1 8.1.1 9.1
TIMELY	Scaffolding is provided as and when the practitioner needs it; e.g., when frustrated due to confused counterparts.	Initiated change in practices is vulnerable due to the implementation dip and potentially confused counterparts.	9.2 10.2
TRANSPARENT	For practitioner: Short-term results and progress are presented to the practitioner in a timely manner – ideally in real-time. For scaffolding resource: Real-time actionable data is generated and processed for oPD to become "smarter" with increasing information.	Short-term and subtle improvement can bridge practitioners "in the dip" over the pitfall between initiated and sustainable change. Transparency enables individualized and timely scaffolding and content curation.	9.2 12.1
COMMITTING	To scaffolding resource: Practitioner is supported by in-person and/or digital scaffolding resource. To work task: The actual work and work process are structured in ways that necessitate the use of the learning.	Personal scaffolding can increase persistence. oPD must be perceived as a direct value or urgent need.	8.2.2 2.1 12.2.2 9.1 11.1 12.1
CONTEXTUAL	oPD is "born contextual" and follows practitioners, offering challenges, information, and support as and when needed. PD content adapts to practitioner's *and* counterparts' needs and progress.	oPD must be relevant and meaningful in situ. Counterparts are critical to oPD effectiveness and must get accustomed to and benefit from the change as well.	9.1 9.2 12.1

13.1. CONTINUOUS

Professional development has neither a start nor an end apart from the entering and exiting of a profession, but even those lines may be blurred. For the practitioner, learning and development occur continuously on the job when something strange is rendered familiar and something familiar is rendered strange – not least when new goals and new people are introduced. PDIs, on the other hand, are most commonly fixed in a limited and specified period of time, with an introduction and a completion. In addition, PDIs are mostly provided course-by-course, often with little cross-intervention coherence (Garet et al., 2001).

One of the benefits of courses like MOOCs is the ample opportunities for flexibility and following individual paces. Nevertheless, instructional PDIs, including KpN, are usually structured around a generalized learning process. RS2 did, however, illustrate how learning trajectories vary greatly. Hence, oPDIs do not support continuous learning in the sense of following the practitioner's performance, learning needs, and contextual challenges; these change with the contexts in which practitioners work. In addition, practitioners in many professions, including teachers, are introduced to a variety of non-related PDIs. Thus, ironically, interventions for what is called "continuous learning" are generally discontinuous.

The discontinuity of oPDIs may have a stake when they are perceived ineffective in changing practices. Alignment of PDIs is critical for the practitioner to experience coherence. Ideally, however, PDIs would not be discontinuous (course-by-course); instead, a way would be found not only to align new initiatives with former initiatives, but to create a technologically mediated framework for continuous PD support in which new theories and standards could be seamlessly introduced.

13.2. TIMESAVING

The importance of having sufficient time to complete and implement oPDIs has been a recurrent theme throughout the dissertation. oPDIs must take into consideration the potential negative influence of time required. Ideally, oPDIs will help practitioners save time by providing tailored and integrated learning processes and content that reduces the time needed to complete current work tasks instead of adding time and work.

The KATA Foundation's aim to integrate KpN into an existing platform, which is sought out by teachers could be a step in this direction. KpN could thus help teachers in their current tasks and be better contextualized; instead of being offered as a course, KpN would become a tool to assist teachers in preparing their classes as per the inquiry-based methods.

13.3. TIMELY

Another temporal element is the timeliness of PDIs. The importance of timeliness is emphasized in Article D (Section 9.2), in which two frustrated teachers exemplified how the likelihood of frustration post-intervention calls for timely identification and support to avoid the termination of initiated change – change that could be sustained into advancement of practices. It was argued that frustration has a transformative potential that may, however, only be realized through situated and timely scaffolding. Chapter 10 suggested mobile technologies, including mobile probes, as a medium to deliver timely scaffolding.

13.4. TRANSPARENCY

Transparency for the practitioner
Transparency in the results of initiated change is critical for the practitioner to find evidence of oPD effectiveness in practice. Article C (Section 9.2) and Article E (Section 12.1) highlighted how PDI-initiated change to practice is sustained only if it yields positive results in the eyes of the practitioner.

Guskey (2002c) suggested leveraging the assessment of PDIs as well as the formative assessments of students' learning to give the practitioner indications of PDI effectiveness. Bearing the frustrated teachers in mind, the degree to which such occasional assessments are sufficient in providing evidence to PDI effectiveness is questionable; subtle and potentially unexpected positive reactions of the counterparts can assist practitioners in persisting until the initial hardship of behavior change and tendency to return to status quo have faded and the effectiveness of the oPDI can be better assessed by the practitioner. Considering the pitfall between initial and sustainable change, designers are advised to prepare practitioners for the implementation dip and provide scaffolding in situ to bring attention to minor and short-term results (or the lack thereof). Providing the practitioner with transparency in a timely way thus becomes vital to a continuous effort to sustain initiated change with the potential to advance practices.

Transparency for the scaffolding resource
Transparency is needed not only for practitioners to effectively assess whether or not initiated change is worthy of sustainment, but competently scaffolding practitioners also requires dynamic continuous assessments of practitioner performance and challenges to support and pressure them to reach their potential (Lajoie, 2005).

Technology may prove valuable in the assessment process. Real-time actionable information could be generated for the practitioner and scaffolding resource to use: "[A]ctionable information refers to such information that will enable a stakeholder to act with the least amount of further processing" (Ginige, 2016, p. 57). Technology can assist in providing dynamic, real-time actionable information on engagement,

learning, and performance of the practitioner and counterparts and thus make way for timely and individualized scaffolding – digitalized and/or in-person. Real-time information may prove critical due to the timeliness needed, and such information may be hard to achieve without the use of technology.

13.5. COMMITTING

That oPD has to be "committing" in order to initiate and sustain change refers to an oPD participant's commitment to a) an in-person or digital scaffolding resource and b) a task or challenge that requires a change in behavior.

Commitment to the scaffolding resource
In RS2, the researcher's physical presence and the teachers' personal commitment to the researcher affected the teachers and seemed to place on them an indirect pressure to initiate change, as discussed in Section 8.2.2. It was argued that the time and effort invested in the PDI work, as well as the initiated change, would likely have been less if the researcher had not facilitated and documented the process as intensely as was the case.

Often, the lack of in-person interaction in online courses is problematized, the argument being that online courses lack the in-person commitment needed to ensure participation and persistence as per the discussion in Article A (Section 2.1.). The rationale is that an instructor's presence and expectations of student participation will naturally increase commitment. In addition, participants will be more receptive to even frustrating information when standing face-to-face with an instructor they do not want to disappoint. A digital instructor is easier to ignore, which contributes to e-Learning having lower exit barriers, as discussed in Article E (Section 12.1). In light of the RS3 participation and commitment challenges, the concern is warranted and argues for use of oPD as a supporting resource for in-person scaffolding encounters. Digital scaffolding resources may prove valuable as a critical supplement to in-person scaffolding. However, entirely digitalized scaffolding resources may have critical affordances, which in-person scaffolding resources do not; This was discussed in Section 12.2.2, which explored adaptive just-in-time learning technologies. Important for committing to oPD, especially for entirely digitalized scaffolding resources, is a perceived direct value and urgently need; this can be achieved when the actual work and work processes are structured in ways that necessitate the use of the oPD technology.

Commitment to the task or challenge
The dissertation has illustrated how participant commitment to complete and act upon oPDIs is increased if the intervention is perceived as delivering on an urgent need or requirement for the practitioner. This was pointed out in relation to the RS2 teachers' strategic narratives in Section 9.1, in which a strategy of acceptance surfaced in a climate of resistance because KpN content could be leveraged to assist with current

tasks and challenges. In addition, Section 11.1 illustrated this with the increased participation in a new 9th grade examination course, and the motivations drivers "urgency" and "requirement" in Article E conceptualized these findings in the intervention-based change model (Section 12.1).

It is important to note that the perception of the need and urgency must stem from the practitioner. Unless participation and behavior change are requirements heavily sanctioned by the initiator, neither the initiator nor the researcher can ensure advancement of practices, as this fully depends on the practitioners' perceptions of oPDI effectiveness in advancing their practices. The need for change may seem evident from the initiator's perspective, but it is the practitioners' perception of the need, urgency, and in situ effectiveness that determines their commitment, their initiated behaviors, and the potential sustainment of these behaviors into advancement of practices.

13.6. CONTEXTUAL

In RS2, the teachers' narratives continuously expressed that the proposed change would not be applicable to their specific teaching situations (see strategies in Section 9.1). There is agreement in the PD field that content must be relevant to the context of the practitioners; consequently, relevance was one of KpN's design principles (Section 6.2). In the literature study in Article A, for example, several of the factors the field has deemed important for e-Learning effectiveness address the relevance of content to learning context: "applicable to practice," "problem-based learning," and "practice" (Section 2.1). Despite this agreement on relevance, a discussion of what constitutes relevance might be beneficial; is relevance obtained by designing content on a generalized practice of the profession, or does proposed change become relevant in the actual context of the individual practitioner? The findings of this dissertation speak to the latter; thus, oPD must do more than show relevance to contexts; oPD must be "born contextual," as in situ experiences of PDI effectiveness are critical to initial change being sustained. Hence, supported by the situated perspective, it becomes appealing to think of content not as "applicable to" but as "becoming relevant in" work practices, which shifts focus from oPDI content transferring to practices to oPDIs as integrated elements of practices.

OPDI must be contextual, because the contingencies of lived practice influence oPD effectiveness; the contextual exigencies not only determine which changes are meaningful to initiate, they determine if initiated change is perceived as effective and consequently sustained. Many online PD courses, including KpN, competently take the context of the practitioner into account and address the challenges of lived practice as described by practitioners. However, situated oPD interventions would not design for the generalized context of the profession. With reference to the previous principles, a contextual PDI follows the individual practitioner in situ and offers timely

challenges, actionable real-time information (transparency to see results), and committing support to contribute to meaningful professional learning and development. Moreover, in anticipation of potentially negative responses by the practitioner's confused counterparts, and in recognition of the counterparts' utmost importance for oPD effectiveness, their needs are essential to consider in design.

With all the design principles combined, the PhD study arrives at a theory of situated online professional development (Situated oPD). This theory contains six design principles which, conveniently for memory, consist of three Cs – Contextual, Committing, and Continuous – and three Ts –Timesaving, Timely, and Transparent.

CHAPTER 14. CONCLUSIONS

This final chapter proposes answers to each of the three research questions and summarizes the key findings and contributions of the PhD research.

Linking to the dialogues in the field of oPD, the literature study (Article A: Section 2.1) found numerous diverse definitions of oPD effectiveness, which highlighted the need not only to clearly define effectiveness but also to challenge the definitions. Additionally, the literature study found that research into the contextual factors influencing the effectiveness of oPD was scarce, as was qualitative empirical research on the effectiveness of oPD. These findings became the point of departure for the dissertation.

14.1. RESEARCH QUESTION 1

To what extent are online professional development interventions effective in advancing work practices?

In RS2, all teachers changed some elements in their teaching, which could be related to their interactions with KpN. They did so to a varying extent and in very different ways. Looking at the variation in terms of the practitioners' performance on behavioral objectives, it was found that evaluating oPD by means of satisfaction surveys or learning outcomes following course completion is problematic; such surveys, commonly used, will not reflect the variation in performance and potential advancement occurring in practice after completion.

Such statements called on the discussion of what constitutes an advancement, and for whom. Whether or not oPD influence constitutes an advancement depended on the position-specific definitions of advancement. In this dissertation, *advancement* was defined as a positive change of work behaviors (Section 1.1.3); yet from an initiator or researcher position, a positive change was linked to the reach of the intervention and increase in performance on pre-defined objectives. For the practitioner, however, an *advancement* required positive reactions from students to teaching behaviors that the teacher attributes to the oPD. Though these definitions of effectiveness in advancing practices coincide, their differences are critical. In this regard, it was established that changes in teaching may meet established learning objectives without necessarily advancing practices, and vice versa; advancements to teaching were made that did not show up on the performance curves.

Hence, oPD initiators and designers could benefit from paying close attention to the practitioners' narratives on oPD effectiveness because the practitioners' in situ definition of effectiveness influences their potential sustainment of intervention-based change, which in turn influences the other measures of effectiveness, including

performance on pre-defined objectives. Caution should be taken in assuming superiority of the external initiator or researcher view on effectiveness, as the PhD research showed that it is from the practitioner position that perceived effectiveness can become reality when initiated change is sustained in ways that are contextually meaningful.

Contrary to the prevailing assumption that stand-alone PD courses are the most effective means by which to advance practices, the PhD research concludes that sustainable change from stand-alone intervention is likely minimal, and hence, so is the advancement the change *may* have brought.

Consequently, it becomes clear that we cannot presume that oPD leads to advanced practices – only that oPD can influence practitioners in their practices to a varying extent. Acknowledging this variation is in itself an important finding for oPD research and design. In addition, the extent to which online professional development interventions are effective in advancing work practices varies with the practitioners' definitions of in situ effectiveness. The findings suggest that stand-alone oPD is effective in advancing practices for more than the self-directed few only to the extent that it is supplemented with competent individualized scaffolding in the pitfall between initial and sustainable change. This concept is expanded in Section 14.2, which addresses research question 2.

14.2. RESEARCH QUESTION 2

When and under which conditions can oPDIs be effective in advancing work practices?

The investigation into the complexity of oPD effectiveness was initiated with RS1, in which the relevance of transfer of learning literature was challenged to be highly context dependent. In terms of inquiry, RS1 underlined that empirical data categories may be important not only because of their presence in data but because of their absence, as illustrated by the category of "manager support." RS1 illustrated how the characteristics of Danish school teachers' work practices ran partly counter to generally accepted promoting factors of oPDI effectiveness in transfer of learning research.

RS2 supported that transfer is situated, and the practitioners seemed to recontextualize oPD in their practices in ways that were meaningful in those specific contexts; this helped explain the variation in the ways in which and the extent to which practitioners performed on the behavioral objectives. The conceptualization of 14 strategies applied by practitioners confirmed that there was no direct transfer of learning to practice in RS2. Instead, the practitioners engaged in complex strategic negotiations of the need

for change and of the effectiveness of KpN, which led to KpN content and objectives being recontextualized – not only modifying practices, but also modifying the oPD content and intended application in ways that seemed appropriate and meaningful for the practitioners, though not necessarily appropriate from the initiator and researcher positions. The narratives showed how collaboration can impede motivation, but they also illustrated how change can still be embraced in a climate of resistance if content adds value to the solution of current tasks and challenges or if evidence is found of oPDI effectiveness in practice.

The work on frustration in oPD defined *frustration* as the inability to meaningfully situate (demand for) the change in current practice. It underlined the great learning potential of frustration and coined transformative and regressive frustration as "the consequential extremities at the tipping point to change." It illustrated how vulnerable an initiated change in teaching is and how sustainable change depends on a complex and apparently unpredictable combination of factors.

The importance of situated relational factors was highlighted in the coining of the term "confused counterparts." The fact that practitioners' counterparts need to adapt and learn when practitioner behaviors change is often overlooked in PDIs like KpN; this is somewhat ironic, as the reactions of the counterparts are often the main goal of the interventions, ex. student engagement for KpN, employee engagement and retention for leadership development. The confused counterpart may instill doubt about an intervention's effectiveness and potentially lead the practitioner to return to the status quo. Thus, it becomes important to ensure that the counterparts find value in and learn how to counterpart the intervention-initiated changes to practices.

Thus, a non-presence of visible results due to a combination of confused counterparts and the implementation dip may become a roadblock for advances to practices as defined from both the teachers' and initiator's perspectives. Consequently, there were elements critical to oPDI effectiveness that could not be explained by the transfer of learning research. This called for looking a step beyond; the findings were thus synthesized into an intervention-based change model. The model's fourth step, from initiated to sustainable change, underlined the shortcomings of viewing advancements as transfer of learning to practice exclusively; the practitioners defined effectiveness *after* they had recontextualized oPD learning in their practices. Many participants in traditional oPD may never get to the fourth step, but it would be a mistake to assume that if they "transfer" learning to their practices, their practices will be advanced.

The unpredictability and changeability of contexts supports the understanding that there is no fixed or generalizable trajectory for development, and the potential extremity of contextual learning variation calls for the provision of individual support in the context of the practitioner's practices. Consequently, scaffolding, which is individualized support by definition, becomes critical to counter the challenges in the unpredictive complexities of situated oPD.

In addressing the second research question, the dissertation concludes that oPD can be effective in advancing practices sustainably when practitioners find evidence of advancement in the initiated change. To complicate matters, contexts are changeable; thus, sustainable change requires conditions of continuous PD scaffolding *in* the practitioners' practices.

14.3. RESEARCH QUESTION 3

How can online professional development interventions be effective in advancing work practices?

This research question was specifically included in the PhD study because the aim was to make a practical difference in oPD research – that is, to generate important knowledge for oPD design in order to increase the likelihood that oPD interventions can advance work practices.

Acknowledging these elements of situated oPD, use of the course formats for PD is brought into question. Individuals develop professionally primarily through the continuously scaffolded practice of the profession. In line with this, the dissertation argues that online PD needs rethinking for intervention-based sustainable change to occur. The article suggests rethinking e-Learning as adaptive online just-in-time technologies for performance support rather than viewing it as a stand-alone replication of face-to-face instruction. The borders of the course format should be challenged, and the question arises whether PD intending to improve work practices belonged in a course format in the first place.

KpN's design principles were based on the transfer of learning literature and thus did not take into account the fourth step of the intervention-based change model, which proved critical for oPD effectiveness. In response to this, a design theory of situated oPD consisting of six new design principles was proposed. The first three principles all address considerations of time. These principles argue that situated oPD would preferably become 1) a *continuous* process, which 2) *saves time* for the practitioner and 3) supports the practitioner in a *timely* manner. The fourth principle speaks to the need for oPD results and progress to be *transparent* for the practitioner as well as for scaffolding resources. The fifth principle underlines the importance for oPD to be *committing*; the practitioners' commitment is seen as critical both toward scaffolding resources and in terms of commitment to the oPD task or challenge due to perceived urgent value. The last principle brings the other principles into play, as it underlines the quintessence of situated oPD: that oPD effectiveness is *contextual* and oPD interventions and technologies are thus well-advised to be contextual as well.

14.4. FURTHER RESEARCH

The RS3 research on KpN2 is ongoing; to a large extent, it investigates the same oPD design as RS2, but different data gathering methods and analyses are used. It will be enlightening to see how the RS3 results complement and potentially challenge the PhD research presented in this dissertation. Further research is needed to evaluate the extent to which the design theory of situated oPD contributes to effectiveness in advancing practices. Based on the theory of situated oPD, an adaptive just-in-time PD technology for team leaders will be developed in 2017; this should contribute further toward investigating the cross-domain potential of the design theory and the developments the theory will require.

LITERATURE LIST

Aarhus University. (2011). *TIMMS undersøgelsen 2011 [The TIMMS Survey 2011]. Trends in International Mathematics and Science Study]*, 2-19. Aarhus, Denmark. Retrieved 2012, Retrieved from http://edu.au.dk/fileadmin/edu /Forskning/Internationale_undersoegelser/TIMSS/TIMSS_2011_resume.pdf

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, *84*(5), 888–918.

Alinier, G., Hunt, B., Gordon, R., & Harwood, C. (2006). Issues and innovations in nursing education: Effectiveness of intermediate-fidelity simulation training technology in undergraduate nursing education. *Journal of Advanced Nursing*, *54*(3), 359–369.

Amiel, T., & Reeves, T. C. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. *Educational Technology & Society*, *11*(4), 29–40.

Amsel, A. (1992). Frustration theory: Many years later. *Psychological Bulletin*, *112*(3), 396–399.

Andersen, R. K., Garp, K., Nellemann, K., Nielsen, M. F., & Ørngreen, R. (2014). A framework for the analysis of collaborative and interactive elements in MOOCs. In R. Ørngreen & K. Levinsen (Eds.), *Proceedings of the European Conference on e-Learning* (pp. 19–28). Copenhagen, Denmark.

Andreasen, L. B., & Buhl, M. (2015). Understanding MOOCs through connectivist and social constructivist approaches. In A. Jefferies & M. Cubric (Eds.), *Proceedings of the 14th European Conference on e-Learning. ECEL 2015* (pp. 34–40). Hatfield, UK: Academic Conferences and Publishing International Limited.

Angeli, C. (2005) Transforming a teacher education method course through technology: Effects on preservice teachers' technology competency. *Computers & Education*, *45*(4), 383–398.

Antonis, K., Daradoumis, T., Papadakis, S., & Simos, C. (2011). Evaluation of the effectiveness of a web-based learning design for adult computer science courses. *IEEE Transactions on Education*, *54*(3), 374–380.

Armatas, C., Holt, D., & Rice, M. (2003). Impacts of an online-supported, resource-based learning environment: Does one size fit all? *Distance Education*, *24*(2), 141–158.

Arnold, I. (2011). John Hattie: Visible learning: A synthesis of over 800 meta-analyses relating to achievement. *International Review of Education*, *57*, 219-221.

Arts, J. A., Gijselaers, W. H., & Segers, M. S. (2002). Cognitive effects of an authentic computer-supported, problem-based learning environment. *Instructional Science*, *30*(6), 465–495.

Avalos, B. (2011). Teacher professional development in *Teaching and Teacher Education* over ten years. *Teaching and Teacher Education*, *27*(1), 10–20.

Aydoğdu Karaaslan, I. (2013). The effect of banking personnel's access to E-learning opportunities on their professional achievement. *Turkish Online Journal of Educational Technology*, *12*(2), 269–280.

Baldwin, T., & Ford, J. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology*, 63–106.

Ball, D. L. (1997). Developing mathematics reform: What don't we know about teaching learning—but would make good working hypotheses? *Reflection on Our Work: NSF Teaching Enhancement in K-6 Mathematics*, 77–111.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147.

Barthes, R. (1981). *Camera Lucida: Reflections on photography*. New York, NY: Hill and Wang.

Bateson, G. (2000). *Steps to an Ecology of Mind*. Chicago, IL: The University of Chicago Press.

Baumeister, R. F., Heatherton, T. F., & Tice, D. M. (1993). When ego threats lead to self-regulation failure: Negative consequences of high self-esteem. *Journal of Personality and Social Psychology*, *64*(1), 141–156.

Beach, K. D. (2003). Consequential transitions: A developmental view of knowledge propagation through social organizations. In T. Tuomi-Gröhn & Y. Engeström (Ed.), *Between school and work: New perspectives on transfer and boundary-crossing* (pp. 39–62). Oxford, UK: Elsevier Science.

Belland, B. R. (2014). Scaffolding: Definition, current debates, and future directions. In M. Spector, M. D. Merrill, J. Elen, M. J., & Bishop (Eds.) *Handbook of research on educational communications and technology* (pp. 505–518). New York, NY: Springer.

Bennett-Levy, J., Hawkins, R., Perry, H., Cromarty, P., & Mills, J. (2012). Online cognitive behavioural therapy training for therapists: Outcomes, acceptability, and impact of support. *Australian Psychologist*, *47*(3), 174–182.

Bennison, A., & Goos, M. (2010) Learning to teach mathematics with technology: A survey of professional development needs, experiences and impacts. *Mathematics Education Research Journal*, *22*(1), 31–56.

Berkowitz, L. (1989). Frustration-aggression hypothesis: Examination and reformulation. *Psychological Bulletin*. Retrieved 2015, Retrieved from http://www.scopus.com /inward/record.url?eid=2-s2.0-0024697035&partnerID=tZOtx3y1

Bessière, K., Newhagen, J. E., Robinson, J. P., & Shneiderman, B. (2006). A model for computer frustration: The role of instrumental and dispositional factors on incident, session, and post-session frustration and mood. *Computers in Human Behavior*, *22*(6), 941–961.

Bill & Melinda Gates Foundation. (2014). Teachers know best: Teachers' views on professional development (pp. 3-16). Retrieved 2015, Retrieved from https://s3.amazonaws.com/edtech-production/reports/Gates-PDMarketResearch-Dec5.pdf

Blazer, K. R., Christie, C., Uman, G., & Weitzel, J. N. (2012). Impact of web-based case conferencing on cancer genetics training outcomes for community-based clinicians. *Journal of Cancer Education*, *27*(2), 217–225.

Blondy, L. C. (2007). Evaluation and application of andragogical assumptions to the adult online learning environment. *Journal of Interactive Online Learning*, *6*(2), 116–130.

Boghikian-Whitby, S., & Mortagy, Y. (2008). The effect of student background in E-learning: Longitudinal study. *Issues in Informing Science & Information Technology*, *5*, 107–126.

Bomsdorf, C. (2013). Danish teacher lockout leaves parents scrambling. Retrieved 2013, Retrieved from http://online.wsj.com/news/articles /SB10001424127887323611604578398630974342000

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*(8), 3–15.

Broad, M. L., & Newstrom, J. W. (1992). *Transfer of training: Action-packed strategies to ensure high payoff from training investments*. Reading, MA, USA: Addison-Wesley.

Brown, K. G. (2005). A field study of employee e-learning activity and outcomes. *Human Resource Development Quarterly*, *16*(4), 465–480.

Buil, I., Hernández, B., Javier Sesé, F., & Urquizu, P. (2012). Discussion forums and their benefits for e-learning: Implications for effective use. Los Foros de Discusión Y Sus Beneficios En La Docencia Virtual: Recomendaciones Para Un Uso Eficiente [English abstract]. *Innovar 22*(43), 131–143.

Burke, L. A., & Hutchins, H. M. (2008). A study of best practices in training transfer and proposed model of transfer. *Human Resource Development Quarterly*, *19*(2), 107-128.

Burr, V. (1995). *An introduction to social constructionism*. London, UK: Routledge.

Charmaz, K. (2012). *Constructing grounded theory*. (2nd ed.) Thousand Oaks, CA, USA: Sage Publications Ltd.

Christensen, O., Gynther, K., & Petersen, T. B. (2012). Design-based research: Introduktion til en forskningsmetode i udvikling af nye E-læringsmetoder og didaktisk design medieret af digitale teknologier [Design-Based Research: Introduction to a Research Method in the Development of New E-learning Method and Didactical Design Mediated by Digital Technologies]. *Læring & Medier (LOM)*, *9*, 1–20.

Ciussi, M., & Freitas, E. G. (Eds.) (2012). *Leading issues in E-learning research for researchers, teachers and students*. UK: Academic Publishing International Limited.

Ciussi, M., Rosner, G., Augier, M., & Suder, G. (2011). M-learning and Y generation: The reality behind the myth. In D. Parsons (Ed) *Combining E-learning and M-learning* (pp. 266–280). IGI Global.

Cobb, P., & Bowers, J. (1999). Cognitive and situated learning perspectives in theory and practice. *Educational Researcher*, *28*(2), 4–15.

Cobb, P., Zhao, Q., & Dean, C. (2009). Conducting design experiments to support teachers' learning: A reflection from the field. *Journal of the Learning Sciences*, *18*(2), 165–199.

Cohen, G. L., & Sherman, D. K. (2014). The psychology of change: Self-affirmation and social psychological intervention. *Annual Review of Psychology*, *65*(1), 333–371.

Collins, A., Joseph, D., & Bielaczyc, K. (2009). Design research: Theoretical and methodological issues. *Journal of the Learning Sciences*, *13* (August 2014), 15–42.

Cresswell, J. W., Plano-Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori and C. Teddlie (Eds), *Handbook of mixed methods in social and behavioral research*, 209–240.

Dede, C., Jass Ketelhut, D., Whitehouse, P., Breit, L., & McCloskey, E. M. (2008). A research agenda for online teacher professional development. *Journal of Teacher Education*, *60*(1), 8–19.

Denzin, N. K. (1978). *The research act* (2nd ed.). New York, NY, USA: McGraw-Hill.

Design-Based Research Collective. (1999). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, *32*(1), 5–8.

Dewey, J. (1963). *Experience and education*. New York, NY, USA: Collier Books.

Duvaa, U., Ørngreen, R., Weinkouff Mathiasen, A-G., & Blomhøj, U. (2013). Mobile probing and probes. In P. Campos, T. Clemmensen, J. Nocera, D. Katre, A. Lopes, & R. Ørngreen (Eds.), *HWID: Work analysis and HCI* (Vol. 1) (161–174). Berlin Heidelberg, Germany: Springer-Verlag.

Egelund, N. (Ed.). (2007). *PISA 2006:Danske unge i en international sammenligning [Danish Youth in International Comparison]*. Copenhagen, Denmark: Danmarks Pædagogiske Universitetsforlag. Retrieved 2012, Retrieved from http://edu.au.dk/fileadmin/www.dpu.dk/omdpu /centerforgrundskoleforskning/internationaleundersoegelser/andreundersoegelser/pisa/om-dpu_institutter_paedagogisk-psykologi_pisa_ 20071204141810_pisa1107v2.pdf

Egelund, N. (2010). Specialundervisning i Danmark, forekomst og effekt [Special Education in Denmark, Occurrence and Effect]. *Unge Pædagoger*, *71*(2), 4–12.

Ejersbo, L. R., Engelhardt, R., Hanghøj, T., Magnussen, R., Misfeldt, M., & Frølunde, L. (2008). Balancing Product Design and Theoretical Insight. In A. E. Kelly, R. A. Lesh, & J. Y. Baek (Eds.), *The Handbook of Design Research*

Methods in Education: Innovations in Science, Technology, Engineering and Mathematics Learning and Teaching. (1 ed., pp. 149-163). Mahwah, NJ, USA: Lawrence Erlbaum.

Emerson, R. M., Fretz, R. I., & Shaw, L. L. (2011). *Writing ethnographic fieldnotes* (2nd ed.). Chicago, USA: University of Chicago Press.

Engeström, Y. (2011). From design experiments to formative interventions. *Theory & Psychology*, *21*(5), 598-628.

Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, *5*(1), 1–24.

Ericson, D. P., & Ellett, F. S. (2002). The question of the student in educational reform. *Education Policy Analysis Archives*, *10*(31), 1-30.

Fenstermacher, G. (1986). Philosophy of research on teaching: Three aspects. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching* (Vol. 3) (pp. 37–49). New York, NY: Simon and Schuster Macmillan.

Fishman, C. G. (1965). Need for approval and the expression of aggression under varying conditions of frustration. *Journal of Personality and Social Psychology*, *2*(6), 809–816.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219–245.

Foucault, M. (1975). *Discipline and punish: The birth of the prison*. New York, NY, USA: Vintage Books.

Fox, S., & Spector, P. E. (1999). A model of work frustration-aggression. *Journal of Organizational Behavior*, *20*(6), 915–931.

Foxon, M. (1994). A process approach to the transfer of training. Part 2: Using action planning to facilitate the transfer of training. *Australian Journal of Educational Technology*, *10*(1), 1–18.

Fullan, M. (2001). *Leading in a culture of change*. San Francisco, CA, USA: Jossey-Bass.

Gallup Consulting. (2013). *State of the Global Workplace*. *Employee Engagement Insights for Business Leaders Worldwide*. Retrieved 2016, Retrieved from http://www.gallup.com/file/services/176735/State of the Global Workplace Report 2013.pdf\npapers2://publication/uuid/4F576D34-017E-4BC6-8B6E-E3760C5FCD5E

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*(4), 915–945.

Gaver, B., & Penningtong, W. (2004). Cultural probes and the value of uncertainty. *Interactions*, *11*(5), 53–56.

Gergen, K. J. (1994). *Realities and relationships: Soundings in social construction*. Cambridge, MA, USA: Harvard University Press.

Gergen, K. J. (2014). Pursuing excellence in qualitative inquiry. *Qualitative Psychology*, *1*(1), 49–60. R

Ginige, A. (2016). Digital knowledge ecosystems: Empowering users through context specific actionable information. In P. Kommers, A. P. Abraham, & Roth Jörg (Eds.), *Proceedings of the International Conference: Big Data Analytics, Data Mining and Computational Intelligence 2016* (pp. 57–65). Madeira, Portugal: IADIS International Association of Development of the Information Society.

Ginns, P., Kitay, J., & Prosser, M. (2010). Transfer of academic staff learning in a research-intensive university. *Teaching in Higher Education*, *15*(3), 235–246.

Gitonga, J. W. (2006). Work environment factors influencing the transfer of learning for online learners. *Online Submission*. Retrieved 2015, Retrieved from http://eric.ed.gov/?id=ED492788

Glaser, B. G. (1978). *Theoretical sensitivity*. Mill Valley, CA, USA: Sociology Press.

Glaser, B. G. (2014). Choosing grounded theory, *The Grounded Theory Review, 13*(2), 3–19.

Greeno, J. G., Smith, D. R., & Moore, J. L. (1993). Transfer of situated learning. In D. K. Detterman & R. J. Sternberg (Eds.), *Transfer on trial: Intelligence, cognition, and instruction* (pp. 99–167). Norwood, NJ, USA: Ablex.

Grgurovic, M., Chapelle, C. A., & Shelley, M. C. (2013). A meta-analysis of effectiveness studies on computer technology-supported language learning. *ReCALL: The Journal of EUROCALL*, *25*(2), 165–198.

Grisaffe, D. B. (2007). Questions about the ultimate question: Conceptual considerations in evaluating Reichheld's net promoter score. *Journal of Consumer Satisfaction, Dissatisfaction & Complaining Behavior*, *20*, 36–53.

Gunawardena, C. N., Linder-VanBerschot, J. A., LaPointe, D. K., & Rao, L. (2010). Predictors of learner satisfaction and transfer of learning in a corporate online education program. *American Journal of Distance Education*, *24*(4), 207–226.

Guskey, T. R. (2002a). Does it make a difference? *Educational Leadership*, *59*(6), 45–51.

Guskey, T. R. (2002b). Professional development and teacher change. *Teachers and Teaching*, *8*(3), 381–391.

Guskey, T. R., & Yoon, K. S. (2009). What works in professional development? *Phi Delta Kappan*, *19*(7), 495–500.

Haigh, J. (2007). Expansive learning in the university setting: The case for simulated clinical experience. *Nurse Education in Practice*, *7*(2), 95–102.

Halawa, S., Greene, D., & Mitchell, J. (2014). Dropout prediction in MOOCs using learner activity features. *eLearning Papers*, *37*(March), 1–10.

Halkier, B., & Jensen, I. (2008). Det sociale som performativitet [The Social as Performativity]. *Dansk Sociologi*, *19*(3), 49–68.

Hara, N., & Kling, R. (1999). Students' frustrations with a web-based distance education course. *First Monday*, *4*(12).

Harrington, N. (2005). It's too difficult! Frustration intolerance beliefs and procrastination. *Personality and Individual Differences*, *39*(5), 873–883.

Harrington, S. S., & Walker, B. L. (2009). The effects of computer-based fire safety training on the knowledge, attitudes, and practices of caregivers. *Journal of Continuing Education in Nursing*, *40*(2), 79–86.

Harry, B., Sturges, K. M., & Klingner, J. K. (2005) Mapping the process: An exemplar of process and challenge in grounded theory analysis. *Educational Researcher*, *34*(2), 3–13.

Hastings, B. M. (2002). Social constuctionism and the legacy of James' pragmatism. *Theory & Psychology*, *12*(5), 714–720.

Hattie, J. (2014). 138 influences related to achievement: Hattie effect size list. Retrieved 2016, Retrieved from http://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 16–7.

Haverila, M. (2010) Factors related to perceived learning outcomes in e-Learning. *International Journal of Knowledge and Learning*, 6(4), 308–328.

Herrington, A., Herrington, J., Hoban, G., & Reid, D. (2009). Transfer of online professional learning to teachers' classroom practice. *Journal of Interactive Learning Research*, *20*(2), 189–213.

Ho, Maris, & Jones, M. (2015). *2015 state of the industry*. Alexandria, VA, USA: ASTD DBA Association for Talent Development (ATD).

Hofmann, J. (2006). Why blended learning hasn't (yet) fulfilled its promise. In C. J. Bonk & C. R. Graham (Eds.), *Handbook of blended learning: Global perspectives, local designs*. San Francisco, CA: Pfeiffer Publishing.

Holton, D., & Clarke, D. (2006). Scaffolding and metacognition. *International Journal of Mathematical Education in Science and Technology*, *37*(2), 127–143.

Hone, K. (2006). Empathic agents to reduce user frustration: The effects of varying agent characteristics. *Interacting with Computers*, *18*(2), 227–245.

Hookway, C. (2016). Pragmatism. In *The Stanford Encyclopedia of Philosophy*. (Edward N. Zalta, Ed.) (Summer 201). Retrieved 2016, Retrieved from http://plato.stanford.edu/archives/sum2016/entries/pragmatism/

Hoskins, S. L., & Van Hooff, J. C. (2005). Motivation and ability: Which students use online learning and what influence does it have on their achievement? *British Journal of Educational Technology*, *36*(2), 177–192.

IDA. (2011). *Prognose for mangel på ingeniører og scient.er. Fremskrivning af udbud og efterspørgsel efter ingeniører og scient.er frem mod 2020. [Prognosis on supply and demand of engineers by 2020]*. (pp. 1-6). Retrieved 2012, Retrieved from https://ida.dk/sites/prod.ida.dk/files/null/prognose20for20mangel20paa20ingenioerer20og20scienter.pdf

Illeris, K. (2006). Læring (Learning). Roskilde, Denmark: Roskilde Universitetsforlag.

Jackson, T. W., & Lichtenstein, S. (2011). Optimising e-mail communication: The impact of seminar- and computer-based training. *International Journal of Internet and Enterprise Management*, *7*(2), 197–216.

James, W. (1907). *Pragmatism: A new name for some old ways of thinking*. Lecture II, Project Gutenberg. Retrieved 2015, Retrieved from http://doi.org/10.1890/09-2296.1.Abrams

Jasper, M. (2006). *Professional development, reflection, and decision-making for Nurses*. Oxford, UK: Blackwell Publishing.

Jefferies, A., & Hardy, J. (2010). How learners change. Critical moments, changing minds. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for a digital age* (pp. 114–127). New York, NY: Routledge.

Jiang, M., Parent, S., & Eastmond, D. (2006). Effectiveness of web-based learning opportunities in a competency-based program. *International Journal on ELearning*, *5*(3), 353–360.

Jibeen, T. (2013). Frustration intolerance beliefs as predictors of emotional problems in university undergraduates. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, *31*(1), 16–26.

Jobe, W., Östlund C., & Svensson L. (2014). MOOCs for professional teacher development. In M. Searson & M. N. Ochoa (Eds.), *Proceedings of SITE 2014—Society for Information Technology and Teacher Education* (pp. 580–586). Chesapeake, USA: Association for Advancement of Computing in Education (AACE).

Jönsson, B., Svensk, A., Cuartielles, D., Malmborg, L., & Schlaucher, P. (2002). *Mobility and learning environments: Engaging people in design of their everyday environments.* Retrieved 2014, Retrieved from http://www.arkiv.certec.lth.se /doc/mobility1/ MobilityLearningReport021215.pdf

Jørgensen, M. W., & Phillips, L. (1999). *Diskursanalyse som teori og metode [Discourse Analysis as Theory and Method]*. Roskilde: Roskilde Universitetsforlag.

Jung, I., Choi, S., Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. *Innovations in Education and Teaching International*, *39*(2), 153–162.

Kachelmeier, S. J., Jones, J. D., & Keller, J. A. (1992). Evaluating the effectiveness of a computer-intensive learning aid for teaching pension accounting. *Issues in Accounting Education*, *7*(2), 164-178.

Kaiden, R. (2002). Lessons from the cyberspace classroom: The realities of online teaching. *The Internet and Higher Education*, *5*(1), 71–74.

Kapoor, A., Burleson, W., & Picard, R. W. (2007). Automatic prediction of frustration. *International Journal of Human-Computer Studies*, *65*(8), 724–736.

Kizilcec, R. F., Piech, C., & Schneider, E. (2013). Deconstructing disengagement: Analyzing learner subpopulations in massive open online courses. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge - LAK '13* (pp. 170–173). ACM.

Klein, J., Moon, Y., & Picard, R. W. (2002). This computer responds to user frustration: Theory, design, and results. *Interacting with Computers*, *14*(2), 119–140.

Korthagen, F. A. J. (2010). Situated learning theory and the pedagogy of teacher education: Towards an integrative view of teacher behavior and teacher learning. *Teaching and Teacher Education*, *26*(1), 98–106.

Kousholt, B. (2009). *Forandringsledelse og forandringskommunikation [Change Management and Change Communication]*. Frederiksberg, Denmark: Samfundslitteratur.

Kumar, J., Yammiyavar, P., & Nielsen, J. (2007). Mind tape technique: A usability evaluation method for tracing cognitive processes in cross cultural settings. *eMinds – International Journal on Human Computer Interaction*, *1*(3), 336-345.

Kvale, S. (1997). *InterView – En introduktion til det kvalitative forskningsinterview [InterView – an Introduction to the Qualitative Research Interview]*. Copenhagen, Denmark: Hans Reitzels.

Lajoie, S. P. (2005). Extending the scaffolding metaphor. *Instructional Science*, *33*(5–6), 541–557.

Lam, M. (2009). Effectiveness of web-based courses on technical learning. *Journal of Education for Business*, *84*(6), 323–331.

Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven, CT: Yale University Press.

Lave, J. (1988). *Cognition in practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. In R. Pea & J. S. Brown (Eds.), *Learning in doing* (Vol. 95). Cambridge University Press.

Lazar, J., Jones, A., Hackley, M., & Shneiderman, B. (2006). Severity and impact of computer user frustration: A comparison of student and workplace users. *Interacting with Computers*, *18*(2), 187–207.

Lazar, J., Jones, A., & Shneiderman, B. (2006). Workplace user frustration with computers: An exploratory investigation of the causes and severity. *Behaviour & Information Technology*, *25*(3), 239–251.

Leberman, S., McDonald, L., & Doyle, S. (2012). *The transfer of learning: Participants' perspectives of adult education and training*. Gower Publishing, Ltd.

Lee, Y., & Choi, J. (2011). A review of online course dropout research: Implications for practice and future research. *Educational Technology Research and Development*, *59*(5), 593–618.

Lieberman, A., & McLaughlin, M. W. (1992). Networks for educational change: Powerful and problematice. *Phi Delta Kappan*, *74*, 673–677.

Lim, D. H. (2000). Training design factors influencing transfer of learning to the education workplace within an international context. *Journal of Vocational and Training*, *52*(2), 243–257.

Lobato, J. (2006). Alternative perspectives on the transfer of learning: History, issues, and challenges for future research. *Journal of the Learning Sciences*, *15*(4), 431–449.

Lucas, G. M., Gratch, J., King, A., & Morency, L. P. (2014). It's only a computer: Virtual humans increase willingness to disclose. *Computers in Human Behavior*, *37*, 94–100.

Mackenzie, N., & Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research*, *16*(2), 193–205.

Majgaard, G., Misfeldt, M., & Nielsen, J. (2011). How design-based research and action research contribute to the development of a new design for learning. *Designs for Learning, 4* (2), 8-21

Maloney, S., Haas, R., Keating, J. L., Molloy, E., Jolly, B., Sims, J. & Haines, T. (2011). Effectiveness of web-based versus face-to-face delivery of education in prescription of falls-prevention exercise to health professionals: Randomized trial. *Journal of Medical Internet Research*, *13*(4), 116

Marsh, C. M., Hannum, W. H., Trotman, C. A., & Proffit, W. R. (2001). Design and effectiveness of a computer-based continuing education program for orthodontists. *The Angle Orthodontist*, *71*(1), 71–75.

Means, B., Toyama, Y., Murphy, R. F., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record*, *115*(3), 1-47.

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, *1997*(74), 5–12.

Miller, L., Ho, M., Frankel, D., & Jones, M. (2014). *2014 state of the industry*. Alexandria, VA: ASTD DBA Association for Talent Development (ATD). Retrieved 2015, Retrieved from http://doi.org/10.1016/B978-0-12-420245-0.00001-8

Moravcsik, A. (2014). Transparency: The revolution in qualitative research. *PS: Political Science & Politics*, *47*(1), 48–53.

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13–22.

Muskat, M., Muskat, B., Zehrer, A., & Johns, R. (2013). Generation Y: Evaluating services experiences through mobile ethnography. *Tourism Review*, *68*(3), 55–71.

Nickel, T. W. (1974). The attribution of intention as a critical factor in the relation between frustration and aggression. *Journal of Personality*, *42*(3), 482–492.

Nielsen, J., Clemmensen, T., & Yssing, C. (2002). Getting access to what goes on in people's heads?: Reflections on the think-aloud technique. In *Proceeding of the Second Nordic Conference on Human–Computer Interaction (NordiCHI'02)*. New York, NY.

Noesgaard, S. S. (2014). Supporting transfer of learning: Practice-based considerations on the applicability of transfer literature in online design. In *Proceedings of 4th International Designs for Learning Conference* (pp. 1–5). Stockholm, Sweden.

Noesgaard, S. S. (2016a). Advancing work practices: Rethinking online professional development in the context of intervention-based sustainable change. *Interactive Technology and Smart Education*, *13*(4), pp. 246-260.

Noesgaard, S. S. (2016b). Can E-learning change work practices? *Proceedings of the Multi Conference on Computer Science and Information Systems (MCCSIS) 2016; E-Learning 2016*. Madeira, Portugal: IADIS International Association of Development of the Information Society.

Noesgaard, S. S., & Ørngreen, R. (2014). Understanding and utilizing the definitions of the effectiveness of E-learning. *Proceedings of the 13th European Conference of E-Learning ECEL-2014* (pp. 445-454). Copenhagen, Denmark: Aalborg Universitetsforlag.

Noesgaard, S. S., & Ørngreen, R. (2015). The effectiveness of E-learning: An explorative and integrative review of the definitions, methodologies and factors that promote e-learning effectiveness. *The Electronic Journal of E-Learning*, *13*(4), 278–290.

Nyberg, A., Bernin, P., & Theorell, T. (2005). The impact of leadership on the health of subordinates. *SALTSA Report 1*, *1*(1), 1-41.

OECD. (2009). *TALIS: Teaching and Learning International Survey. Creating effective teaching and learning environments. First results from TALIS*, 3-305. Paris, France: OECD Publishing. Retrieved 2012, Retrieved from https://www.oecd.org/edu/school/43023606.pdf

OECD. (2015). Fostering teachers' professional development. In D. Orr, M. Rimini, & D. van Damme (Eds.), *Open educational resources: A catalyst for innovation*. Paris, France: OECD Publishing.

Ørngreen, R. (2015). Reflections on design-based research - in online educational and competence development projects. In *4th IFIP 13.6 Working Conference, HWID 2015, London, UK, June 25-26, 2015, Revised Selected Papers* (pp. 20–38).

Ørngreen, R., Jørgensen, A. N., & Noesgaard, S. S. (2016). Mobile probes: A scaffold for peer and self-regulated learning. *Proceedings of Designs for Learning 2016*. Copenhagen, Denmark: Alborg Universitetsforlag.

Palloff, R. M., & Pratt, K. (2001). Learning lessons from the cyberspace classroom. *17th Annual Conference on Distance Teaching and Learning*, (pp.1-5).

Patterson, B. J., Krouse, A. M., & Roy, L. (2012). Student outcomes of distance learning in nursing education: An integrative review. *Computers, Informatics, Nursing: CIN*, *30*(9), 475–488.

Pawliczek, C. M., Derntl, B., Kellermann, T., Gur, R. C., Schneider, F., & Habel, U. (2013). Anger under control: Neural correlates of frustration as a function of trait aggression. *PLoS ONE*, *8*(10).

Poepsel, M. A. (2011). *The impact of an online evidence-based coaching program on goal striving, subjective well-being, and level of hope*. *Archivos Analíticos de Políticas Educativas*. Capella University. Retrieved 2015, Retrieved from http://scholarcommons.usf.edu/coedu_pub

Potter, J., & Wetherell, M. (2007). *Discourse and social psychology: Beyond attitudes and behaviour*. London, UK: Sage Publications Ltd.

Preece, J., Rogers, Y., & Sharp, H. (2002). *Interaction design: Beyond human-computer interaction*. Ney York, USA: John Wiley & Sons.

Regeringen. (2012). *Gør en god skole bedre - et fagligt løft af folkeskolen. [Make a good school better]*, 5-53. Retrieved 2012, Retrieved from http://www.uvm.dk/Aktuelt/~/UVM-DK/Content/News/Udd/Folke/2012/Dec/121204-Goer-en-god-skole-bedre-et-fagligt-loeft-af-folkeskolen

Reichheld, F. F. (2003). The one number you need to grow. *Harvard Business Review*, (December), 1–14.

Robinson, D. N. (1993). Is there a Jamesian tradition in psychology? *American Psychologist*, *48*, 638–643.

Rosenberg, H., Grad, H. A., & Matear, D. W. (2003). The effectiveness of computer-aided, self-instructional programs in dental education: A systematic review of the literature. *Journal of Dental Education*, *67*(5), 524–532.

Ross, J. (2006). The reliability, validity, and utility of self-assessment. *Practical Assessment, Research & Evaluation*, *11*(10), 1–13.

Sassi, N., El Akremi, A., & Vandenberghe, C. (2015). Examining the frustration-aggression model among Tunisian blue-collar workers. *Journal of Managerial Psychology*, *30*(3), 336–353.

Schlager, M., & Fusco, J. (2003). Teacher professional development, technology, and communities of practice: Are we putting the cart before the horse? *The Information Society*, *19*(3), 203–220.

Sherman, D. K., & Cohen, G. L. (2002). Accepting threatening information and the reduction of defensive biases. *Current Directions in Psychological Science*, *11*(4), 119–123.

Short, H. (2014). A critical evaluation of the contribution of trust to effective technology enhanced learning in the workplace: A literature review. *British Journal of Educational Technology, 45*(6), 1014–1022.

Siemens, G. (2013). Massive open online courses: Innovation in education. In McGreal, R., W. Kinutha, & S. Marshall (Eds.), *Open educational resources: Innovation, research and practice*, 5–16. Vancouver, Canada: Commonwealth of Learning, Athabasca University.

Sim, J., & Radloff, A. (2008). Enhancing reflective practice through online learning: Impact on clinical practice. *Biomedical Imaging and Intervention Journal*, *4*(1), 1–13.

Small, G., & Vorgan, G. (2008). Meet your iBrain. How technologies that have become part of our daily life are changing the way we think. *Scientific American Mind*, *October/November*, 42–49.

Sprague, D. (2006). Research agenda for online teacher professional development. *International Journal of Teacher Education, 14*(4), 657–661.

Staddon, J. E. (1970). Temporal effects of reinforcement: A negative "frustration" effect. *Learning and Motivation*, *1*(3), 227–247.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of learning sciences* (pp. 409–426). Cambridge, UK: Cambridge University Press.

Steele, C. M., & Liu, T. J. (1983). Dissonance processes as self-affirmation. *Journal of Personality and Social Psychology, 45*(1), 5–19.

Steele, C. M., Spencer, S. J., & Lynch, M. (1993). Self-image resilience and dissonance: The role of affirmational resources. *Journal of Personality and Social Psychology, 64*(6), 885–896.

Stout, S. C., Boughner, R. L., & Papini, M. R. (2003). Reexamining the frustration effect in rats: Aftereffects of surprising reinforcement and nonreinforcement. *Learning and Motivation, 34*(4), 437–456.

Strauss, A. L., & Corbin, J. M. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 273–285). London, UK: Sage Publications.

Sutton, R. E. (2007). Teachers' anger, frustration, and self-regulation. *Educational Psychology: Emotion in Education*, 259–274

Sziraki, M. (1978). Mental and biological assimilation and accommodation. *Canadian Psychological Review/Psychologie Canadienne*, *19*(1), 67–73.

Thompson, G., & Vecchio, R. P. (2009). Situational leadership theory: A test of three versions. *Leadership Quarterly*, *20*(5), 837–848.

Thornberg, R. (2012). Informed grounded theory. *Scandinavian Journal of Educational Research*, *56*(3), 243–259.

Thorndike, E. L., & Woodworth, R. S. (1901). The influence of improvement in one mental function upon the efficiency of other functions. *Psychological Review*, *8*(3), 247–261.

TNTP. (2015). *The mirage: Confronting the hard truth about our quest for teacher development*. New York, NY: TNTP. Retrieved 2015, Retrieved from http://tntp.org/assets/documents/TNTP-Mirage_2015.pdf

Torkzadeh, R., Pflughoeft, K., & Hall, L. (1999). Computer self-efficacy, training effectiveness and user attitudes: An empirical study. *Behaviour and Information Technology*, *18*(4), 299–309.

Tuomi-Grohn, T., & Engestrom, Y. (2003). *Between school and work: New perspectives on transfer and boundary-crossing*. Oxford, UK: Elsevier Science.

Undervisningsministeriet. (2009). *Flere fag i folkeskolen skal dækkes af linjefagsuddannede lærere [More Subjects in the Danish Elementary School Must be Taught by Specialized Teachers]*. Retrieved 2012, Retrieved from http://www.uvm.dk/Aktuelt/~/UVM-DK/Content/News/Udd/Videre/2009/Juli/090706-Flere-fag-i-folkeskolen-skal-daekkes-af-linjefagsuddannede-laerere

UNI-C. (2009). *Undersøgelse af linjefagsdækningen i folkeskolen. Gennemgang af resultater* [Investigation of the teacher specializations in Danish K-9 schools. Walk-through of results]. Copenhagen, Denmark: UNI-C. Retrieved 2012, Retrieved from http://www.emu.dk/sites/default/files/090706_Rapport_linjefag_2009_0.pdf

Usher, E. L., & Pajares, F. (2007). Self-efficacy for self-regulated learning: A validation study. *Educational and Psychological Measurement*, *68*(3), 443–463.

van den Akker, J. (1999). Principles and methods of development research. In J. van den Akker, R. M. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.), *Design approaches and tools in education and training* (pp. 1–14). Dordrecht, Netherlands: Kluwer Academic Publishers.

Van Maanen, J. (2011). *Tales of the field: On writing ethnography* (2nd ed.). Chicago, USA: University of Chicago Press.

Veneri, D. (2011). The role and effectiveness of computer-assisted learning in physical therapy education: A systematic review. *Physiotherapy Theory and Practice*, *27*(4), 287–298.

Vithal, R., & Valero, P. (2002). Researching mathematics education in situations of social and political conflict. In A. J. Bishop, C. Clemens, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Second international handbook of mathematics education* (Vol. 2), (pp. 545–592). New York, USA: Springer Science & Business Media.

Vygotsky, L. S. (1978). Interaction between learning and development. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind in society: The development of higher psychological processes* (pp. 29–36). Cambridge, USA: Harvard University press.

Wahlgren, B. (2009). Transfer mellem uddannelse og arbejde [Transfer between Education and Work]. Nationalt Center for Kompetenceudvikling (NCK). Retrieved 2012, Retrieved from http://www.regionh.dk /NR/rdonlyres /D1A3FC8E-632B-499F-89B4-9CB7E992CE01/0/100324_Transfer_mellem_uddannelse_og_arbejde_Bjarne_Wahlgren_NCK_august_2009.pdf

Wahlgren, B., & Aarkrog, V. (2012). *Transfer: Kompetence i en professionel sammenhæng* [Transfer: Competence in Professional Context]. Aarhus, Denmark: Aarhus Universitetsforlag.

Wakelam, E., Jefferies, A., Davey, N., & Sun, Y. (2015). The Potential for Using Artificial Intelligence Techniques to Improve e-Learning Systems. In *ECEL 2015 Conference Proceedings* (pp.1-10), Hatfield, United Kingdom.

Whittemore, R., & Knafl, K. (2005) The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553.

Workday (2016). A New Model for User Engagement. Retrieved 2016, Retrieved from http://static.webwereld.nl/downloads/610_workday-a-new-model-for-user-engagement-uk.pdf

Yu, R., Mobbs, D., Seymour, B., Rowe, J. B., & Calder, A. J. (2014). The neural signature of escalating frustration in humans. *Cortex*, *54*, 165–178.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology*, *25*(1), 82–91.

SUMMARY

The natural expectation for professional development courses is that they will improve a participant's work performance, but do they? This PhD research challenges several assumptions underlying the design of online professional development courses, revealing that it is after such interventions that the real challenge surfaces. The challenge of transferring learning to initiate change in work behaviors is present in extant research, but research has not yet thoroughly investigated that even when change is initiated, the effectiveness of the course is still being tested. For sustained change, practitioners must find evidence of the effectiveness of changed behavior in practice. Practitioners may feel insecure and incompetent when doing their jobs differently, and individuals at work may react to changes in behavior in unexpected ways. This leads practitioners to conclude that a course was not effective and subsequently terminate change that could have advanced their practices. This underlines the need to think beyond the course format to make online professional development interventions continuous, committing, and contextual. The research suggests rethinking online professional development as adaptive "just-in-time" technologies and proposes a design theory called "situated online professional development," entailing six design principles for advancing work practices.

ISSN (online): 2246-123X
ISBN (online): 978-87-7112-850-5

AALBORG UNIVERSITY PRESS